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Financing Problems Will Be Solved

JUST how and when electric utilities will get the definite government aid in financing which they expected is not plain at the moment. The prospect is not discouraging, because the matter is too vital to the integrity of the national position to be long neglected. We have every faith that in some way the problem will be solved. The first shock resulting from the interpretation of the act creating the War Finance Corporation by the directors of that emergency body served the good purpose of focusing the attention of bankers on the crisis. Now we are at a point where it is seen by Washington and by Wall Street, as well as by the public utility operators themselves, that concerted action must be taken to prevent dangerous potentialities from running too far.

The practical question of financing covers broadly two classes of necessities. One is that of the maturity of outstanding securities or the funding of short-time bank loans; the other is that of providing for construction cost on plant or line extensions required for war or community uses. In many cases these will have to be cared for separately or by different government or private agencies. The two classes, however, are somewhat intermingled. Neither one can be disregarded safely. And all acute financing necessities under war conditions lead inevitably to the rates.

The directors of the War Finance Corporation are not culpable for desiring that utilities which go to them shall be able to stand up financially. As bankers, as good business men, as lenders of government funds, they naturally want to take a minimum of risk, to get a maximum of protection. What we think they have failed to appreciate is the purely emergent character of the situation they deal with. When the government is at war and ordinary business and commercial practices are suspended it is not the time to be a stickler for the normal rule. You simply can't keep things normal. But the fact that the War Finance Corporation directors want to be assured of sound earning capacity in utilities may after all be effective in strengthening the will of state commissions to grant speedy relief in rates.

In measuring dollars we should keep foremost in mind the strident fact that purchasing power has changed. The return on the new investment to-day is much less than fair when that investment has to depend on a rate which has not been increased to square with present costs. The dollar invested does not buy so much equipment or apparatus as it did. The output of the equipment or apparatus is measured in the kilowatt-hours, but the revenue from the kilowatt-hours is inadequate unless it is as much greater in proportion than the old rates yielded as the investment and operating cost is greater than the old cost would have been. In brief, if a given new investment in line or apparatus yielded 8 per cent under the old conditions, it would yield say 2 or 3 per cent with present costs, assuming no advance in rates.

These figures are of course subject to variation for individual properties. They are qualified by the consideration that they apply to the new-investment proportion of a company; and that equity of return may be secured either by a large advance in rate for those served by the new property or by a smaller average increase for all customers, whether served by old or new property. But the main argument holds, that rate of return on the investment is a diminishing quantity unless consumers' rates are figured with fair allowance for the costs of operation and extensions under war conditions.

Development of Aerial Power Cables

PRESENT conditions have demanded very rapid increase of power distribution on a large scale. The conditions are commonly enough met by ordinary high-tension construction, but many cases, particularly in thickly settled parts of the country, arise in which this ordinary construction cannot be conveniently used. For some years past the need has been met in such instances by the use of leaded and armored aerial cables such as have already been described in these columns. The paper presented by E. B. Meyer before the A. I. E. E. convention gives an admirable summary of current practice in this highly specialized line. Experience has proved that ordinary leaded cable is too heavy for convenient use, and as a result of much study a special type of cable (armor over reinforced rubber insulation) has been developed which is some 50 per cent lighter than the equivalent leaded cable and seems to meet admirably the somewhat difficult requirements.

The cables are carried on messenger wires, following the usual practice of the earlier telephone cable, and by thorough grounding of this and connecting it also with the armor of the cable proper it is found that the protection from lightning is excellent, in all probability considerably better than would be obtained by the usual forms of line construction. Most of the existing circuits are of 15,000 volts and less, but the same methods have been successfully applied up to 26,000 volts, and there seems to be no reason why still higher powers could not be employed. The Public Service Electric Company

of New Jersey, which has developed this method of line construction, has now in service nearly 25 miles (40.2 km.) of high-tension cable, some of which has been in use for the past seven years with a very striking degree of success. The results, in fact, have been so gratifying as to lead to considerable recent extension of this cable construction, which, without superseding the simpler and more general methods, has certainly a considerable field of usefulness.

America's Electrical Energy Supply

AGAIN the profession is indebted to Dr. C. P. Steinmetz for a most suggestive and striking discussion of the sources of energy available for industrial use. He views the subject in the large, considering the national resources of coal and water power as a potential whole. We have vast stores in this country of undeveloped coal fields and undeveloped water powers, but the total of the latter is, according to Dr. Steinmetz's figures, unmistakably less relatively to the utilization of fuel than one would at first thought suppose. Computing the total water power of the country through mechanical integration, so to speak, of the rainfall and heights above sea level, with due allowance for wastage of every kind in water rendered unavailable, it turns out that twenty-four-hour power of 230,000,000 kw. is approximately the final limit of utilizable energy which can be derived from water power between 30 deg. and 50 deg. north latitude on this continent. The startling bearing of this figure is that it is only about equal to the present total energy consumption of the country and but little more than the total allowance of annual energy produced from coal. In other words, great as is this potential power, it is not enough, even if all utilized, to supply materially more than the present needs of the country were the coal supply to fail, let alone the requirements at some point in the future when there will actually be a serious fuel shortage due to exhaustion of our resources.

A large part of the available hydraulic energy is in comparatively small units, and as Dr. Steinmetz points out, it needs a radical, although perfectly feasible, simplification of methods in order with reasonable economy to collect this scattered energy into a general source of distribution. Of the total potential hydraulic supply by far the larger part is, temporarily at least, economically unavailable. As fuel costs rise, either from actual exhaustion of the supply or by the stern compulsion of deep and difficult mining, more and more of the smaller and less promising water powers will become practically useful; but when that evil time approaches it is safe to say that the energy requirements of the country will have increased at so rapid a rate that even complete utilization of the water powers will afford small measure of relief. It is instructive thus to cast forward and endeavor to see to what ends the failing fuel supply may lead us.

At the present time all the great civilizations of the world lie in climates where mankind stands in sore need of fuel merely for necessary heating. A serious fuel shortage would render a large part of the now civilized world practically untenable by humankind through a large part of the year. As such a period arrives civilization must adjust itself to the new conditions, either by drifting permanently southward to more genial climates or by trying grimly to hold its own by the utilization of every available form of energy.

Dr. Steinmetz very properly called attention to the enormous unutilized solar energy, many times in amount all other sources combined. Numerous attempts have already been made to utilize solar energy, with a fair degree of success. The practical limitation is not in the present somewhat crude apparatus, which is susceptible of great improvement, but in the average cloudiness of a large part of the earth's surface. Solar radiation is chiefly available in the two great though somewhat ill-defined dry belts north and south of the equator, running, for example, through Egypt and Arabia, across our own Southwest and far beyond the Pacific in a strip of continental Asia. In this area one can even now obtain a horsepower eight hours a day from about 100 sq. ft. (9.2 sq. m.) of mirror surface, a figure which can doubtless be improved. It should be noted, however, that the chief available source of solar energy lies in rather low latitudes and not in the regions which are now the centers of the world's activity. Again this condition points to the ultimate drift of population and of great civilizations to lower latitudes, to the regions where in fact the ancient empires grew and flourished before mankind drew upon the earth's stored fuel supply for warmth. One can well imagine such a drift, associated perhaps with marvelously developed north and south transportation to take advantage of the great fertile country during its annual period of usefulness.

Whatever there may be in such speculations, it is at least very plain from Dr. Steinmetz's figures that if our energy requirement goes on increasing for the next century at anything like the present rate, steps more radical than hydraulic development must be taken to keep pace with the world's needs. This does not, however, excuse mankind from failing to develop the resources of hydraulic power for all they are worth, thereby putting off the evil day in which the ultimate dilemma must be faced.

The Perennial Off-Peak Problem

THE central-station operator should read with keen interest James R. Cravath's consideration of the relation of the coal situation to the station loads. Next winter we are going to pass through a situation perhaps more serious than that of last winter. The zone system inaugurated by the Fuel Administration will help to a certain extent at the cost of relatively small inconvenience in burning unwonted kinds of fuel. It will not, however, remedy the shortage of coal due to lack of mine production and the difficulties of transportation, which are steadily increasing. The combined effect of war and fuel shortage has been to increase station loads very considerably, in fact, to an extent which keeps one guessing as to whence machine capacity can be derived. Almost the first effect of the increase in fuel costs has been to put a heavy handicap on small isolated plants, many of which were already, perhaps unwittingly, running at costs high compared with central-station service. Not a few of them have discovered the truth of the situation, and steadily more

and more isolated plants are shut down and their loads transferred to the general service available. We have more than once noted the desirability of meeting the difficulties of the situation by interconnection of public service companies on a large scale so as to take advantage of all the available aggregate capacity and of the total diversity factor.

Mr. Cravath lays special stress on the desirability of getting off peak load both to increase the general efficiency of the station and to conserve machine capacity. Under present circumstances new equipment is both costly and difficult of attainment, and every possible effort should be made to utilize to the utmost both the generating capacity and the copper installed. This means coming to as nearly a full twenty-four-hour load as ingenuity can suggest. Mr. Cravath's hint as to taking over isolated-plant load through the summer is a good one where it can be applied. The main trouble is that not all systems have valleys in the load curves during the day, and it would mean additional load imposed upon the central stations through war conditions. Any off-peak scheme is practical and if properly handled will lead to prices of power so reasonable that in many instances it would pay the manufacturer to see if he could not arrange to work efficiently without calling for heavy power at the time of maximum peak. With the present tendency toward a general eight-hour day, this particular problem is somewhat simplified; but its solution is a task which belongs as much to the manufacturer as to the central station, and possibly the final effort will have to be made by the Fuel Administration. Certain it is that we are "up against" another season of shortage and must meet the situation thoughtfully and cheerfully.

Protection Against Flashovers

THE A. I. E. E. convention paper by J. J. Linebaugh and J. L. Burnham deals with a matter of particular importance in heavy railway service. Generators or synchronous converters of very large output are now and then exposed to most serious short-circuit conditions. If these are not too severe, the circuit breakers take care of the situation successfully, but there comes a time when even the brief short circuit permitted by the breaker is sufficient to cause arcing at the brushes which becomes continuous in a flashover. A great deal has been done to check this tendency by a strong commutating field, and with a considerable measure of success. Yet as machines have grown bigger and bigger, and as heavier and heavier demands have been put upon them, the dangers seem to have outrun the protection so far as this particular measure is concerned. The authors of the paper here considered set themselves the task of producing as complete protection against flashover as engineering skill could furnish, and they appear to have reached a degree of success that is most gratifying.

To a certain extent the tendency to flashover can be resisted by barriers between the brushes, just as it has been often checked in switches by a similar device. But this alone has never been fully successful, since in the case of very violent short circuits the arcing would get out of control even in the brief period required to get the ordinary circuit breaker into action. The line of improvement adopted by Messrs. Linebaugh and Burnham is twofold—first, to cut down to the utmost possible extent the time of operation of the circuit breaker, so that a flashover arc would have scant time to start, and, second, as an auxiliary measure, to furnish barriers to prevent arcing from brush to brush under the severest conditions of practice. Considering the fact that direct-current railway machinery is now built both for very high output and large voltage, the importance of these protective devices is self-evident. The authors, in fact, did a large part of their testing in connection with a 2000-kw., 3000-volt motor-generator set in railway service, which involves a constant threat of severe short circuit.

The chief form of improvement was directed to speeding up the circuit breakers to the utmost limit attainable. The ordinary big breaker begins to act in about 0.15 second, which is far too long a period of short circuit for safety against flashing. The authors therefore set out by careful mechanical design to get a very quick-acting breaker. As finally developed, it included a powerful spring actuating the relatively light moving parts, a tripping coil acting on a hair trigger, which opened the main trip on a movement of one-thousandth of an inch, and finally a series blow-out coil powerful enough to keep pace with the enormously rapid opening, reaching in fact under extreme conditions 150,000 ampere turns. By this ingenious combination it was possible to provide a high-capacity breaker which would open in rather less than a hundredth of a second. Even this speed was not quite sufficient to avert all danger with an open commutator, but the addition of a carefully designed set of barriers fulfilled all the requirements so that even the biggest generators could be adequately protected. The reader will find in this paper both many interesting details of the carrying out of the work and the results obtained by oscillograms and instantaneous photographs of the incipient arcing, as well as the data relating to miscellaneous researches of a highly promising character.

The Coming Issues

MUCH has been said about conservation of fuel by assuring efficient combustion, but not enough attention has been directed to the benefits that can be derived from efficient utilization of the steam which is generated at the expense of coal. While turbines will maintain a high efficiency if properly cared for and operated, the steam economy will be greatly impaired if they are neglected. In a coming issue, therefore, the principal causes of impairment of economy will be discussed and suggestions given on how the trouble may be detected and prevented in the future. Another article will refer to experiments which have been conducted with a lightning arrester that works on a different principle from those now in use. The instruction course that an Eastern university is giving to state inspectors on illumination requirements in industrial plants will be outlined, and in line with the general economies now practiced in central stations the method used by one company in economizing in poles and conductor expense will be described.

What Commissions Are Doing on Rates

Attitude of Various State Regulatory Bodies on Questions of Rate Increases Due to Higher Costs of Operation and Effect of War Conditions—Fuel and Labor Are Vital Points

This continues the series begun in the issue of June 8, 1918, showing the attitude of public service commissions on rates. It will be followed by other articles in later issues.

RATE cases which go before the state commissions under war conditions are extraordinary emergencies and are generally so recognized by the authorities. Under these circumstances the commissions appear to be disposed to minimize the usual preliminaries and requirements of costly and delayed appraisal and investigation and to grant relief without serious delay. Only by reducing the time of handling these cases can they in fact afford relief promptly. Any return to the old practice of devoting years to a rate case would fail to meet the emergency nature of the crisis.

Position of New Hampshire Commission

From the New Hampshire Public Service Commission a representative of the ELECTRICAL WORLD obtained the following:

Increased cost of operation is the basis of rate raises so far permitted by the commission, but in cases where other factors make an extended investigation necessary the mere fact of increase in operating cost might not in itself be sufficient to justify permitting the scheduled advance to go into effect.

Particular rate changes have been allowed to go into effect without the disapproval of the commission, and in general it may be said that each schedule is treated by itself, with due regard to the possibilities of discrimination against other users of service.

Since April 1, 1917, four increases in electrical rates have gone into effect; none has been rejected. Public hearings were held upon the cases of the Plymouth Electric Light Company and the Rockingham County Light & Power Company, Portsmouth, relative to increase in price to 20 cents per kilowatt-hour in the former instance and the establishment of a coal clause in the latter. The Twin State Gas & Electric Company, Dover, established a coal clause during the period (5 mills per kilowatt-hour, power only). There has been no general opposition to these rate changes except that the Plymouth case was heard at length. At present the commission has under consideration the schedule of the Rockingham County company for rate advance through service charge.

The Plymouth case was the only one since April 1, 1917, which required an extended investigation. It is not known at this date whether the proposed service charge of the Rockingham County company will be permitted to go into effect without investigation. This depends in large measure upon whether a statutory complaint arises relative to the proposed schedule prior to the expiration of the thirty days' period which must elapse after filing before the new rate may become effective.

Roughly, the increases in lighting and power rates are of the order of 10 per cent each, but it is difficult to state accurately the percentage advance in revenue to be derived from rate changes, in view of the number of factors in rate structures to be taken into account.

Not over 7 or 8 per cent of the electrical utilities under the commission's supervision filed rate schedules looking toward increased revenue in the above period.

Predictions are uncertain, but in general it may be assumed that the commission looks upon the war as the dominant factor in present operating cost increases. Presumably there will be some recession of costs after the close of hostilities, but the commission is not disposed to set a limit to this recession more than to express its doubt as to the return of prices of fuel and labor to the ante-war levels.

View Taken by Wyoming Commission

H. A. Floyd, secretary Wyoming Public Service Commission, says:

"In a few cases we have authorized electric utilities to increase rates on a showing of increased cost of operation where the operating cost had increased to such proportion that the utility was really suffering. In two different cases we have approved these increases for all classes of consumers. In two other cases we have permitted utilities to increase with their power consumers only.

"We have had within the past six months applications for rate increases from four electric utilities. In one of these utilities permission was granted to increase the rates approximately 10 per cent; in another case, where there had been competitive plants and a rate war, an advance of more than 200 per cent was allowed on general lighting consumers, about 25 per cent on cooking and electric appliances and more than 100 per cent on power consumers. The other two utilities were permitted to increase upon their power consumers, by and with the consent of the consumers, the increased cost of fuel amounting to between 10 and 25 per cent.

"About 10 per cent of the electrical utilities under our jurisdiction are seeking certain advances in their rates. From our study of the general conditions we are of the opinion that the situation at the present time is partially a war emergency, but that there may be a period of at least two or three years after the war before the situation will be as normal as it was in 1917 or previous years. The greatest difficulties which the electric utilities are encountering are the two items of fuel and labor—fuel having advanced in a number of cases as high as 400 per cent and labor advancing from 25 to 100 per cent. Under the latter item less efficiency is being secured with the advanced cost of labor than in previous years."

Nevada Little Affected

F. O. Broili, chief engineer Public Service Commission of Nevada, sends the following in answer to our inquiry:

"Our State is a small one in the matter of number of

inhabitants. With that in mind we would answer your questions as follows:

"We have one case, that of a water company, before us for an increase in rates owing to decrease of the population in the community affected. We have made no decision as yet in the above case.

"We have received no application for increases in rates of electric utilities. We know of none that are contemplating asking higher rates. As practically all of the power here is produced from water-power plants, we do not feel that there will be any material change in the cost of power as far as this State is concerned, and such as is likely to develop in this State will probably be due largely to labor conditions, and this matter will probably adjust itself after the war."

APPLICATIONS IN UTAH

T. E. Banning, secretary Public Utilities Commission of Utah, writes:

"Increased rates are authorized upon a showing as to the increased cost of operation, where it is also shown that the public utility has not in the past earned in excess of a reasonable return upon the investment. No discrimination has been shown as between different classes of consumers. Where increases have been granted they have applied to all classes of service.

"Only six applications have been received for permission to increase electric rates within this State during the past fifteen months. Five applications have been granted and one is pending. Where increases have been granted utilities furnishing metered service, the increase has averaged 20 per cent. In one instance a change from flat to meter rate was authorized, and the minimum charge increased from 50 cents to $1, or 100 per cent. No applications have been rejected. One application is pending before the commission. Approximately 10 per cent of electric utilities in this State are seeking higher rates.

"It is impossible at this time to state definitely whether increases granted and sought will become permanent or if they will be subject to deduction after conditions return to normal. Each case is handled solely upon its merits, and rates will be subject to review at a later date."

ACTION TAKEN IN MARYLAND

Benjamin T. Fendall, secretary Maryland Public Service Commission, writes to the ELECTRICAL WORLD:

"I am directed to advise that under the public service commission law this commission has no power to suspend the application of increased rate schedules pending investigation as to the reasonableness of the rates and charges therein contained, the only requirement in this respect being that the rate schedule be filed with the commission not less than thirty days before the effective date thereof. The utilities under the jurisdiction of the commission, therefore, formulate the schedules and file same with the commission, the schedule automatically becoming effective on date provided unless in the interim the commission should have conducted an investigation into the reasonableness of the increased rates and found same to be in violation of the law, in which case the commission must enter its order establishing reasonable rates for the future.

"Since Jan. 1, 1917, changes in the electric rates have been made by twenty utilities, which is about half the total number of electric companies under the jurisdiction of this commission, and it is practically impossible to give you any estimate of the average increases that would be of any value to you whatsoever.

"Practically all of these utilities have increased their rates to all classes of users, the only exception being in the case of the Consolidated Gas, Electric Light & Power Company of Baltimore, which, of course, is a much larger one than any other electric utility in the State. The Consolidated company has not increased the rates for domestic service or for small commercial consumption but has added a fuel rate adjustment clause which is applicable to the larger users of the company's service.

"There has been no formal case filed with the commission respecting the reasonableness of any of the increased rates except in the case of the Consolidated company. Hearings in this case have been concluded, and the matter will be argued before the commission.

"The commission prefers not to hazard a guess as to whether or not the utilities will go back to their prewar conditions in all respects upon the termination of the war."

APPLICATIONS IN INDIANA

Carl H. Mote, secretary Public Service Commission of Indiana, writes as follows:

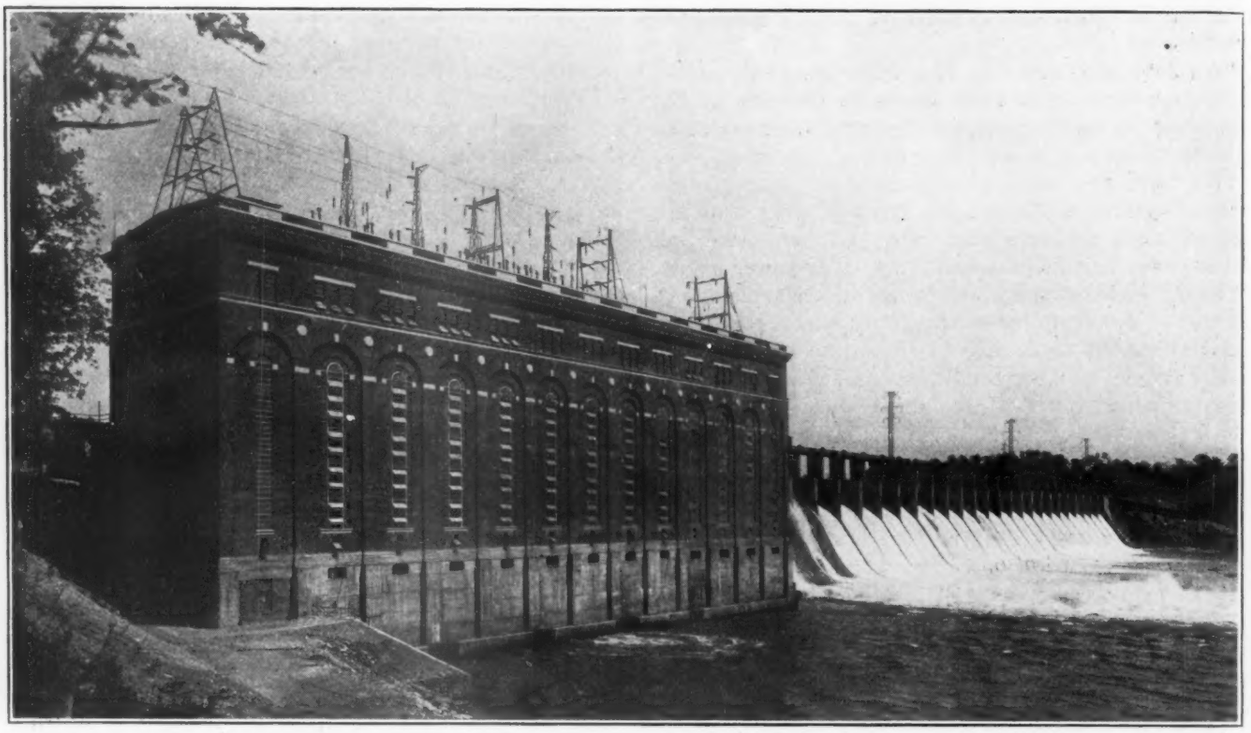
"We have authorized a great many electrical utilities to increase their rates on a showing of increased cost of operation. This increase has been granted in the form of a surcharge without any disturbance of the permanent rate structure, and the surcharge is made to expire at a given date, say one or two years from the date granted. Generally speaking, increased rates for electric energy or surcharges have been applied at a flat rate upon power, though several increases have been authorized upon all schedules. The Merchants' Heat & Light Company of Indianapolis and the Indianapolis Light & Heat Company were authorized to add a surcharge of 5 mills per kilowatt-hour to all bills for light and power except bills for energy furnished to domestic consumers.

"The commission has granted approximately eighteen applications from electrical utilities to increase rates and has denied seven petitions of this character. No advance, I believe, has been greater than 5 mills, and the amount has ranged downward.

"Probably five or six petitions from electrical utilities have been filed quite recently which ask for increased rates.

"Every increase authorized by this commission since the declaration of war is made to expire at a given date or with the end of the war. We have no reason for believing that the general operating conditions of electrical utilities will be changed permanently by present conditions. In fact, increases have been authorized particularly on account of the increased cost of coal, labor and material, all of which are certain to recede at the close of the war.

"I may say that, in addition to the petitions heretofore referred to, the commission early last year received a petition from the Indiana Electric Light Association on behalf of its membership for authority to add a surcharge of 30 per cent to all bills for all kinds of service. This petition was dismissed, and the membership of the association were directed to file individual petitions which would be considered upon the individual merits of each petitioner."



COOSA RIVER STATION OF ALABAMA POWER COMPANY, FROM WHICH ELECTRICITY FOR NITRATE PLANT NO. 1 IS OBTAINED

Electricity for Government Nitrate Plants

Two Plants Now in Process of Erection in Alabama Will Have Steam Stations Pending Hydroelectric Development on the Tennessee River at Muscle Shoals

THERE are under construction near Sheffield, Ala., two government nitrate plants, one employing the synthetic process, the other the cyanamide process. While for years there has been a systematic effort made to have the government permit the development of the waters of the Tennessee River at Muscle Shoals for the purpose of manufacturing nitrates, nothing has been done and probably nothing will be done until after the war on any hydroelectric development there for nitrate purposes. Meanwhile the nation is engaged in war and has need of nitrates for munition purposes. The exigencies of the case therefore demanded the erection of steam stations for the supply of the necessary electricity, even though water-power sites exist in the vicinity. The accompanying map will give some idea of the size of the government reservations and their proximity to the proposed hydroelectric plants on the Tennessee River, one of which it is expected will be erected after the war. Three dams are contemplated: Dam No. 1 for purposes of navigation only and Dams Nos. 2 and 3 for the development of electricity.

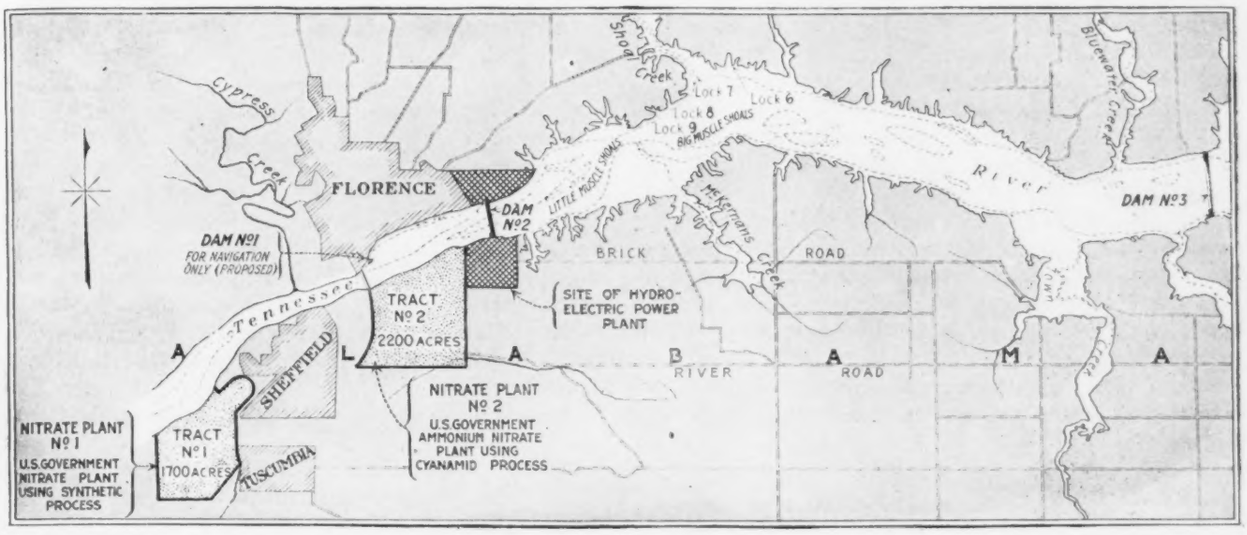
Nitrate plant No. 1 now being constructed from an appropriation of $20,000,000 will use a synthetic ammonia process. Part of the ammonia will be oxidized to nitric acid and the final product will be ammonium nitrate. The output in terms of nitric acid is to be 200,000 lb. a day, and the electricity will be supplied by the Alabama Power Company, which has a hydroelectric station on the Coosa River and an auxiliary steam station near the mouth of a coal mine on the Warrior River.

Nitrate plant No. 2 is being built by the Air Nitrates Corporation acting as agent of the Ordnance Department. The process used will be identical with that employed in the present plants of the American Cyanamid Company. The limekilns will burn 350,000 tons of lime per annum and the coke dryers will handle 100,000 tons. Carbide furnaces will fuse the lime and coke, after which the product will be cooled, ground and placed in ovens of one ton capacity, for treatment with nitrogen. The liquid-air plant for nitrogen production will have a greater capacity than that of all similar plants now existing in the United States and the Dominion of Canada.

The cyanamide, which contains from 20 to 21 per cent of nitrogen, will be cooled, ground, placed in autoclaves and treated with steam, to produce ammonia. In the cyanamide process this gas when mixed with air is passed through a heated platinum screen, whence the nitrogen is oxidized by catalysis. The oxide gases are then cooled and absorbed. One-half of the ammonia produced in the autoclaves will be thus oxidized and combined with the rest of the ammonia for the production of ammonium nitrate. The power requirements will be 60,000 kw., to be supplied from a steam turbo-generator station erected at the plant. Electricity from this steam station will, however, be superseded by electricity from a hydroelectric plant to be erected subsequently at Muscle Shoals.

The government, in addition, has under contemplation the erection of two other nitrate plants in Ohio, one at Elizabethtown and the other at Toledo. Both plants combined will have an output equal to Nitrate Plant No. 2, located at Muscle Shoals in Alabama. While no definite decision has yet been made relative to the Ohio plants, it is generally understood that the power requirements will be met by existing central stations in the vicinity.

It is of interest to note in this connection that the steam turbines required by the government for its various nitrate and munition plants have been commandeered from the central stations of the country, the government to substitute other units for those taken.



MAP OF GOVERNMENT NITRATE-PLANT RESERVATIONS AT MUSCLE SHOALS, ALA.

Relation of Coal Situation to Central-Station Load

Off-Peak Service with Attractive Rates Is Urged for Those Isolated-Plant Customers That Are Forced Through Fuel Conditions to Take Electric Energy Supply from Power Company

BY J. R. CRAVATH

NO CENTRAL-STATION man needs to be told that the present coal situation is having a very strong tendency to build up central-station load. The load is coming fast enough; in fact, too fast. The central-station manager is in much the same position as a cautious man learning to run an automobile. He is concerned not so much with keeping the thing moving as with how to steer and control the "gol-durned thing" so that it will not run away with him and cause a wreck. The question is how to handle the additional load with minimum investment and plant extension rather than how to get the load.

Before attempting to discuss the best ways of handling the load which is being thrown upon central stations as a result of the present coal situation a few words as to how and why the load is coming are in order. The increase in coal prices since the beginning of the war has tended to make central-station power more economical than power generated in small plants, where before the balance was about even or in favor of the small plant. This is because the cost of fuel is usually a much larger percentage of the total cost of power in a small plant than in a large economically managed central station. For example, a 10 per cent increase in coal prices means more to a small plant where the coal cost is 50 per cent of the total than in a central station where the coal cost is, say, 10 per cent of the total. This is given merely as an example to illustrate the point and not as any average figure for isolated versus central-station plant economy. In this connection it must be remembered that difference in pounds of coal required per kilowatt-hour in the two plants is not necessarily a measure of the difference in fuel costs, as the small plant frequently has to burn more expensive fuel, so that the difference in coal costs per kilowatt-hour is considerably more than the difference in plant performance.

The uncertainty of coal supply throughout the winter and the absence of storage facilities also tend strongly to make the isolated-plant owner seek central-station power. Many isolated plants are not so situated that they can maintain adequate storage to tide over winter months, and they are faced with the possibility of a worse coal famine than last winter. Even where storage can be used, the cost of putting coal in and out of storage materially runs up the total coal cost and acts as the equivalent of an advance in price.

The zoning system of the United States Fuel Administration whereby the plants in any given locality will be required to use coal from mines nearest to that locality and save long shipment will force some plants to use a lower grade of fuel than formerly. As much of

the high-grade smokeless fuel has been used for domestic purposes rather than steam-plant purposes through the Middle West, this new system will not affect central-station loads as much as the reduction in coal tonnage shipped might indicate. The principal use of anthracite and high-grade West Virginia smokeless coal through the Middle West has been by small domestic consumers and by large buildings in big cities. As these buildings will have to have heat in any event, they will be obliged to equip to burn whatever fuel they can get, and therefore the influence that the change will exert on the power load is somewhat in doubt as yet.

The general principles which should be followed by central-station companies in meeting this increasing load situation are simple. The added load should be kept off of the present peak-load period as much as possible. Make existing apparatus carry this new load to as great an extent as may be and save investment in additional plant. The interests of the company's stockholders and of the United States are identical in this respect, because saving in central-station investment means saving in men and materials much needed elsewhere for war purposes.

In the past central stations have made special off-peak rates, but inertia and dislike to change established customs have prevented many customers from taking advantage of these, even though there may have been no real good reason why they should not. These war times are helping us to pull ourselves out of many bad ruts of conservatism, and now of all times would seem to be the opportunity to advance the off-peak load idea more fully than ever before.

The Old Question of the Off-Peak Load

This brings us around to the old question of what classes of load can be made off-peak. The taking over of an isolated plant furnishing lighting—for instance, for office or apartment buildings—offers an opportunity for off-peak load only in the way already indicated as having been adopted by some large buildings. This is to throw the entire power and lighting load onto the central station during the summer time. By allowing the central station to carry the load at all times except during the prohibited peak period the isolated-plant owner can make a very material reduction in fuel consumed even if his plant cannot be entirely shut down.

Where the isolated plant to be shut down is one operating an industry which does not have to run twenty-four hours per day the periods of shut-down for that industry can be regulated, prejudice and custom to the contrary notwithstanding. Public service commissions in the past have usually required public utility companies to give services wherever demanded, if given according to the rules of the commission. Were an industry to demand central-station power and insist upon taking it during peak period, paying the regular rate therefor, the central station could not, under past rulings, refuse it. However, it will not do to assume that customers will insist on regular peak power where it is not absolutely necessary for them, or that regulating commissions will not recognize the present special war conditions and require some concession on the customer's part where this is feasible.

The analysis of the operating and investment costs necessary to make a proper off-peak rate should have been made by every central station before this, but if not, now is the time, if ever, to make this analysis.

The first thing in such a study is to determine what is the real peak which it is desirable to avoid. It is also necessary to consider whether this peak is likely to be shifted by conditions of the immediate future. In determining what is the peak which is to be avoided a good criterion is to see whether the cutting off of any given peak would result in a lessening of the total station capacity required to supply the load on the system. On systems where the peak is of short duration during the maximum months of November and December a schedule which would call for the shutting off of off-peak power only a few hours per year might make possible carrying considerable additional connected load. One must always remember, however, that the tendency of central-station load is toward broader peaks as the diversity of load increases. If care is not taken in formulating the off-peak hours, the off-peak load itself may sooner or later contribute to a broadened peak. One must look ahead to these possibilities in establishing an off-peak schedule.

The investment required to supply an off-peak load as compared to a peak load involves an analysis of the extra investment required to supply an off-peak load over and above the investment if the off-peak load were not there.

Beginning at the consumer's end of the distribution system, the meter and service wire investment is the same for an off-peak as for a peak load customer of a given size. The transformers on an alternating-current system may be usable both for peak and off-peak customers, but in the case of large power customers frequently this transformer investment is peculiar to the individual customer, just as are the service connections and feeders. Feeders will usually be usable by both classes of customers, the same being true of substations and transmission lines. Of course, no two consumers are situated exactly alike, and it is necessary to strike some kind of an average just as in making other rates. The power-station equipment is obviously usable by both classes of customers.

This brings us to a rather fine point in rate making, which is whether the off-peak customer should pay part of the fixed charges on investment which is needed anyway to serve the regular peak customer. On one side is the argument that the addition of the off-peak customer does not add to the company's investment in certain items and therefore the off-peak customer should not be charged with it. On the other side is the argument that since both the off-peak and the peak customer enjoy the benefits of the investment it should be in some way divided between them, though by no stretch of the imagination could it be justly claimed that an off-peak customer should pay as much per kilowatt of maximum demand as a peak-load customer. If the principle of making rates according to true costs is followed, the off-peak customer will evidently have to pay a portion of the fixed charges on the investment required to serve him and the peak-load customer will have to pay a similar portion and in addition all of the fixed charges on the special peak-load investment required to serve him. To state the matter in another way, below a certain load-curve line the investment charges would be divided between these classes of customers, and above that line the investment would be chargeable altogether to the peak load customer.

"WASTEFUL DELIVERY METHODS CAN NO LONGER BE TOLERATED. SHORT-HAUL, MANY-STOP DELIVERIES ARE THE FIELD OF THE ELECTRIC TRUCK. EIGHTY-FIVE PER CENT OF CITY HAULAGE CAN BE ACCOMPLISHED BY THE ELECTRIC VEHICLE"

The Electric Vehicle as a War Measure

Offering an Economical Solution for an Important Part of the Nation's Big Transportation Problem, It Presents an Opportunity to the Central-Station Industry of Which Every Advantage Should Be Taken

BY JAMES H. McGRAW

This address was made by Mr. McGraw at the Atlantic City convention of the National Electric Light Association, June 14.

TRANSPORTATION is one of the vital problems of the day. It deserves the attention of the biggest men in every industry. War has enormously increased congestion in factories, on railroads, in warehouses and terminal yards and on our city streets. We have more raw materials and more products to handle with fewer men, and with the need for real economy in handling costs.

More minds are being concentrated on transportation than ever before. Government officials, Washington bureaus, the War and Navy Departments, as well as engineers, central-station men, electrical engineers in industrial plants—all are considering parts of the problem.

TRANSPORTATION CONDITIONS

A brief survey of transportation problems in this country brings striking facts to light. Forty-five per cent of the population live in 11 per cent of the area of the United States. This restricted area includes the New England States, New York, Pennsylvania, New Jersey, Maryland, Ohio, Indiana and parts of Illinois and Michigan.

Of all goods made in the United States, approximately 70 per cent are made in this area. This concentration of population and manufacturing brings naturally a congestion of traffic that is little realized until a tremendously added burden is put on it by war needs.

Within the congested area is a still smaller zone which to-day is the red-flag zone of the government departments. In this zone, which borders the Atlantic and extends from Baltimore to Maine, there are no raw materials, no bituminous coal, no iron or other basic supplies. To get these raw materials into this region they must go through four gateways—Williamsport, Altoona, Shippensburg and Baltimore. To get coal and basic supplies into the great manufacturing district of New England, where there are so many war plants, there are three gateways—the Harlem River, Poughkeepsie and Albany.

We must win this war with our present main equipment. We haven't time to build more gateways, more railroads, more trunk lines. The so-called red flag zone the next year will require 90,000,000 tons of bituminous coal, 80,000,000 tons of hard coal. All this product must go through the four gateways.

What does this mean? Broadly, it means that we must concentrate our attention on auxiliary means of transportation to move goods faster and transfer goods more quickly at this point. Every freight car must count. According to lately gathered statistics, we need 150,000 cars for replacement alone. The government ordered 100,000—a tremendous order, it is true, but only a part of what is needed to handle materials.

Electricity offers three means of auxiliary aid to the steam railway freight problem at this time. Various classes of hoists and transfer cranes and platforms operated by electricity are in use. Second, there is the industrial electric truck, a low-body, small-wheel vehicle which is being used for transfer work in government yards, docks and terminals, munition factories and so forth, and third, commercial electric trucks for short-haul, many-stop deliveries from warehouse to merchant, from merchant to customer.

In all these fields the electric vehicle is now performing work of direct help in war service, and there is a very real opportunity to extend this development tremendously.

Electric industrial trucks are being used more extensively than is generally realized in direct government work. Hundreds of trucks are in use at embarkation and debarkation points. Practically all goods going into France are handled at some point by electric trucks. Special trucks with crane and hoist attachments have been developed. Because of the nature of the work, it is not possible to describe these applications in detail.

The average cost of operating an electric industrial truck of this kind, including tires, battery upkeep, mechanical repairs, charging, drivers' wages and in-

terest on investment, is between $5 and $6 a day. In many instances one truck will do the work of four to six men. In one instance a truck saved eighteen men a day. These trucks have a speed of 5 miles (8 km.) an hour loaded and a capacity of two tons. They are particularly serviceable in operating in munitions factories because the risk of fire is practically negligible. These trucks are being built by hundreds. There are estimated to be 5000 in use to-day.

Specialized electric trucks for government service have also been built for hospital supply wagons and ambulances at base hospitals. An electric kitchen wagon also has been built. Electric tractors are in operation at the navy yards and supply depots for hauling ammunition cars.

Warehouse and Terminal Handling Offer Chance

The war has especially shown the inefficiency of our methods of handling goods out of cars, across platforms and into warehouses. Goods are handled and rehandled without regard to time or labor. This is one of the biggest parts of our transportation problem.

It should be a matter of pride to realize that electricity at the terminals and gateways is helping to move goods more cheaply and faster. The industrial electric truck, the electrically driven overhead crane, the hoist and telpher systems operated by electricity, the night illumination, are all factors in this problem.

Electricity is helping to get the job done, and the demand for the industrial electric truck for this work is ahead of the supply, although the trucks are being turned out by several manufacturers. For loading and unloading steamships the electric industrial truck has found a place, not only because it saves time and labor but because practically every other type of power vehicle is eliminated from both docks and steamships by insurance companies on account of fire risks.

Electric Trucks in Munition and Other Factories

Industrial electric trucks are helping to get work done in munition factories and arsenals. They have revolutionized the methods of handling goods in many plants. These factories need to-day to increase output by every possible means. They also need to conserve men, both laborers and mechanics. The industrial electric truck replaces men, speeds up production and is so simple a mechanism that it requires little skilled attention.

As a concrete example of what an industrial truck will do the Packard Motor Car Company has three electric industrial trucks handling scrap material from the lathes and presses where formerly forty-eight men were required.

Electric transportation in the factory is simply another example of the widening use of electricity in industries. Central-station service and the motor drive have been adopted. The power engineer from the central station has had an opportunity to act as an electric engineer of transportation and to point out to the factory manager just what electricity can do for transportation to his factory.

Local delivery methods are getting the same overhauling as railway, terminal and factory systems. Men are growing scarcer. Wasteful delivery methods can no longer be tolerated. The problem is part of the complete city transportation needs.

The Commercial Economy Board of the Council of National Defense has just issued a booklet entitled "Economy in Retail Service." The Council of National Defense as a whole also has made this statement: "The Council of National Defense has given its formal approval to all measures designed to facilitate the use of motor trucks in transportation wherever they can be utilized. It is urging all communities as far as possible to adapt the motor truck to their local needs and encourage its use in any way to help existing transportation problems." In neither of these pronouncements is direct reference made to any type of motor truck, but the general idea of replacing horse-drawn trucks and, perhaps more important, antiquated delivery systems is being widely promoted.

The booklet issued by the Commercial Economy Board is part of a broad program started in 1917 to show how economies introduced by voluntary co-operation of business would release men, materials, equipment and capital for carrying on the war. The work in retail deliveries was undertaken primarily to conserve labor, to make it unnecessary for merchants who lost delivery men through the draft and other war causes to replace them out of supplies available for shipbuilding, farming, railway transportation and other war work. A careful survey of the whole country was made among retail and wholesale merchants.

Several of the findings of this survey point particularly to present opportunities for the electric vehicle to meet the problem of local delivery under war conditions. In Massachusetts it was found that 5230 stores, about half in the State, operated 4473 vehicles. Of these, 3129 were horse-drawn and 1344 were motor trucks. This general proportion of horse-drawn and motor-propelled trucks holds for the country.

A second point in this general investigation worth the attention of the electrical industry is the relative importance of this transportation cost as an element in the merchant's total cost. In the city of Washington the delivery costs for bakery products averaged 19.8 per cent of gross sales; for dairy products, 12.1 per cent; for ice cream, 14.9 per cent; for coal and wood, 15.2 per cent; for ice, 45.6 per cent, and for food products, as a whole, 7.4 per cent.

Short-Haul, Many-Stop Deliveries the Field

The report contains definite suggestions for changing the methods of delivery. It points out that short-haul, many-stop deliveries generally provide the best service to the customer, and it suggests plans for working out such systems. This, of course, is the ideal field for the electric vehicle. Ninety-five per cent of the work done by horses on the street can be done by motor trucks. Eighty-five per cent of the city haulage can be accomplished by the electric vehicle. Figures compiled many times show the inherent economy of the electric used in place of the horse-drawn wagon. A light truck will move a single-horse wagonload of goods a mile for 1 cent (energy at 3 cents per kilowatt-hour). Gasoline for that same mile would cost 3 cents and oats for the horse 5 cents. And this is only one element in the cost.

All of the coal used in the Hudson Terminal Building in New York City is hauled from Jersey City by two 5-ton electric trucks. By hauling the coal from storage and buying in large volume, the company saves $45

per day. The ferry charges were reduced several dollars a day because the electric truck for the same capacity was about three feet shorter than a gas truck and so came in a lower class. The cost of handling fuel is one of the elements in our fuel supply that are receiving careful analysis. The electric truck with a suitably adapted body is an economical solution of the problem. In one case now being investigated one 5-ton truck with different detachable bodies could replace both horse-drawn and gas equipment, eliminate surplus equipment and effect a saving of about 35 per cent to 40 per cent.

I have briefly summarized the way in which electricity is a part of the transportation problem to-day.

General Advantages

The general advantages of the electric vehicle as a part of the big transportation problem may be summarized as follows:

Manufacture. — Simplicity of design, requiring few parts; almost total absence of machined steel in power plant; need of skilled mechanics reduced to a minimum.

Operation. — Skilled mechanics unnecessary; young and old, men and women, are successful operators.

Maintenance. — Few parts and absence of reciprocating features assure maximum uninterrupted service with minimum supervision and repair, thus releasing skilled mechanics for more vital war work.

Operating Costs. — Lowest for work accomplished of all forms of mobile transportation.

Fuel.—Energy for battery charging taken off-peak.

Conditions abroad are not the same as in this country. We are not yet faced with the drastic shortages in liquid fuel and operators that have faced our Allies. The fact remains, however, that the electric vehicle has filled a very definite place in the transportation development abroad. For example, there have been six times as many "electrics" put into service in England alone during the last three years as in all the time before. Electric vehicles have been adopted for handling municipal work, for example, in eighteen towns and cities, for garbage collection, road construction, street cleaning and coal deliveries. The Midland Railway has about 110 electric trucks in service, and the Great Northern Railway has eight 3½-ton trucks. American electric trucks displaced the entire horse unit in Leeds, thirty-three horses and sixteen vans.

The Electric Vehicle Section of this association has been working with the French High Commission in New York looking forward to the manufacture of the electric vehicle in France as a part of the great problem of reconstruction and water-power development under way in that country.

Norway is to-day an active market for the electric vehicle, both commercial and pleasure cars.

THE ELECTRIC VEHICLE COMING INTO ITS OWN

The electric vehicle is classifying itself, coming to its own, by a situation that is brought about not by the vehicle itself but by national economics. This is a time when the thought of the nation is concentrated on the cost of distribution. Our cost of distribution when compared with the cost of production has been extraordinarily wasteful. Undoubtedly the electric vehicle promises to play a large part in the solution of our terminal problems. These problems to-day are of the greatest national importance, and when the victory is won we shall need still more the best of terminal facilities to develop and carry on the stupendous international trade with which we hope to be overwhelmed.

The port of New York cannot liberate itself with sufficient rapidity. We have streets filled with horse trucks, and inefficient methods of getting materials away from terminals. There is a clinker in the grates of the transportation problem. We must devise means of getting rid of it so as to keep a lively draft and keep up circulation.

In my judgment, looking at it in its broadest aspect, I believe the key to the solution of this problem and the clearing up of the terminal condition lies in the electric vehicle.—*From the discussion of "The Electric Vehicle as a War Measure," by J. W. Lieb, Past-president of the N. E. L. A.*

Central Station's Rôle

This discussion has been undertaken to bring before this association, not the detail economies of the electric vehicle, which are well known, but the opportunity that the central stations of the country have to aid the government by taking an active part in helping to solve the transportation problem as a whole. The central stations to-day are furnishing light, heat and power to meet war needs and to conserve men and materials in the commercial and domestic life of the nation.

The transportation problem needs the attention of our biggest electrical men. Transportation to-day is handled with tremendous losses. The movement of freight to-day is a transportation engineering question. As an engineering question the electrical industry will play a large part in solving it. The supply of electricity for the big developments to come, in cheapening the cost of handling goods in terminals and warehouses and in cutting the cost of deliveries on our city streets, is worth the attention of every central station in the nation.

The electric vehicle to-day offers an economical solution for an important part of our big transportation problem.

Power Factor and the War

Present Conditions All Over the Country Due to the National Emergency Make It More than Ever Essential to Obtain Maximum Use from Equipment— One Way Is to Improve Power Factor

BY WILL BROWN

Electric Machinery Company, Minneapolis, Minn.

CENTRAL-STATION companies formerly avoided discussing the subject of power factor because it involved some complications in rates and metering. But "times change and men change with them." We are at war. Waste must be eliminated.

The cost of transmission lines is greatly increased by low power factor. For example, the number of pounds

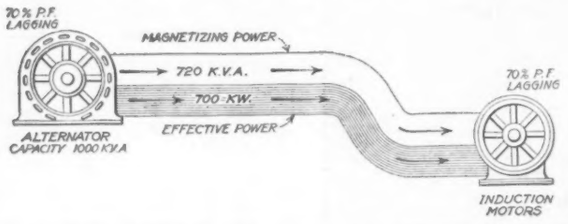


FIG. 1—MORE USELESS THAN USEFUL CURRENT CIRCULATES WITH 70 PER CENT POWER FACTOR

As a result larger conductors and switching equipment are required, the apparatus supplying energy must be larger, and maintenance of constant voltage is more difficult.

of copper required on a transmission system operating at 70 per cent power factor is at least 33 per cent more than is required if the system operates at 90 per cent power factor; but very often the nearest standard-size wire (or gage) may considerably exceed the exact requirements (in circular mils). Thus the percentage of cost may be largely increased, in some cases to the extent of 60 per cent. That is, if the system at 90 per cent power factor requires 100,000 lb. (43,360 kg.) of copper, the system at 70 per cent power factor requires 159,000 lb. (72,120 kg.) of copper, it being understood that both are 60-cycle systems with the same line drops, operating at full capacity and carrying the same rated kw. load. Think of it! Nearly 60 per cent more copper used to carry reactive current.

One can go further into this matter of waste caused by low power factor by considering the two systems compared below, each having 3000 kw. in motors. System A operates at a power factor of 90 per cent lagging (3333 kva.), whereas system B operates at a power factor of 70 per cent lagging (4285 kva.). Both deliver the same power, viz., 3000 kw. The initial costs of the two systems are as follows:

	System A	System B
Generators*	$34,200	$44,100
Transmission lines	45,000	72,000
Transforming and switching equipment	7,000	9,250
Motors, etc.	35,400	35,400
Total	$121,600	$160,750

*Prime movers not included.

Nearly $40,000 worth of additional equipment must be installed to enable system B to operate at 70 per cent power factor and still carry the same kw. load as system A at 90 per cent; and this is by no means all the waste involved, for there is a constant loss due to greater heating caused by the low power factor.

The proper use of synchronous motors—that is, for the type of duty for which they are adapted—will go a long way toward relieving conditions of low power factor. Synchronous motors for power-factor correction should be installed as near as possible to the causes of lagging power factor. The reactive current then circulates between the induction motors and the synchronous motors only, and the generators and distributing lines are relieved thereof.

There is another way of looking at the value of improving power factor which should be particularly interesting at this time, and that is that larger loads can be carried without increasing the generating, transforming or distribution facilities if the power factor is raised. This may afford the quickest way of providing for increased production since it does not involve the purchase, delivery or installation of a large amount of equipment. As an example of what can be done along this line attention may be called to one plant which was operating at an average power factor of 72 per cent lagging and which was driving about 1400 hp. of induction motors of various sizes ranging from 1 hp. to 200 hp. It became absolutely necessary that a large motor be added to the line for driving a compressor. The alternators were already loaded to the safe overload capacity. A 500-kva. synchronous motor was added to the system to drive the compressor (about 280 hp.). By overexciting the motor so it would run at a power factor of 42 per cent leading it was possible to raise the power factor of the system to approximately 90 per cent. The same alternators are now driving the original 1400 hp. of motors plus the 280 hp. used for the compressor and are actually generating less kva.

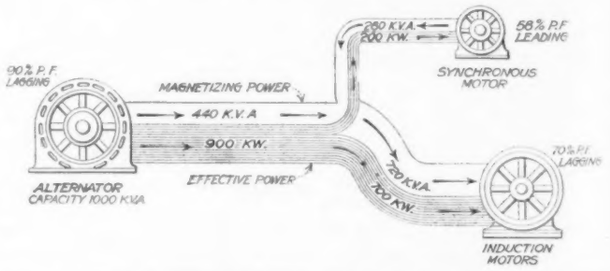


FIG. 2—MIXING SYNCHRONOUS APPARATUS WITH INDUCTION MOTORS REDUCES USELESS CIRCULATING CURRENT

The synchronous equipment can also carry load and permits using smaller conductors, switches, etc., or at least allows using the reserve capacity for other purposes. Reserve capacity is also released in the energy-supply apparatus.

than before. Under the new conditions it requires only 1400 kva. at 90 per cent power factor to serve nearly 300 hp. more equipment than under the former condition when the alternators were delivering 1460 kva. at 72 per cent power factor. (See Fig. 1.)

Serving war industries has brought many problems to central-station companies, since munition factories are

almost invariably bad offenders as regards production of low power factor. For instance, one of the large government arsenals has a generating plant of its own with a capacity of about 8000 kva. In addition to this it also receives power from the local central-station company. The present power factor at the switchboard is about 70 per cent to 75 per cent lagging. A new ordnance factory is about to be added, known as the "field and siege plant." This new plant will be equipped with 4000 kw. of induction motors, but the average power required of these motors when they are all running will probably not exceed 1500 kw. This will mean very poor power factor, possibly 55 per cent to 60 per cent lagging or even lower. Consequently there will be a serious problem for the central-station company unless something is done to raise the power factor of the government plant. To correct the conditions the plant engineers are considering using synchronous motors of relatively large kva. capacity to drive a number

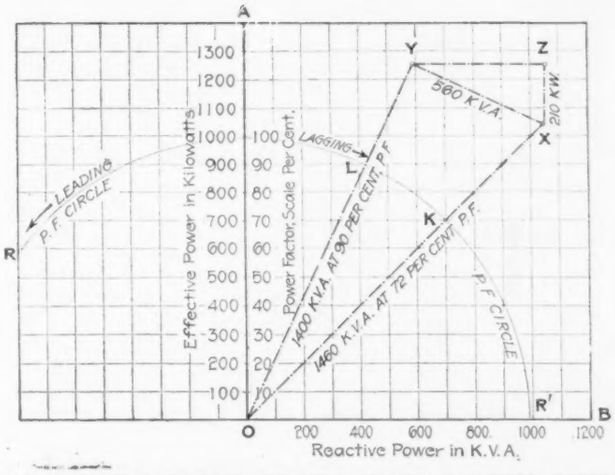


FIG. 1—VECTOR DIAGRAM SHOWING EFFECT OF RAISING POWER FACTOR FROM 72 PER CENT TO 90 PER CENT BY SYNCHRONOUS MOTOR

The synchronous motor rated at 500 kva. is delivering 210 kw. of mechanical power at the same time that it is correcting the power factor of the system. The original system was delivering 1460 kva., of which only 1050 kw. was employed usefully for mechanical power. After the addition of the synchronous motor the system delivered 1260 kw. of mechanical power, while the apparent kva. was reduced from 1460 to 1400. By similar diagram any one can figure the size of the synchronous condensers required to produce the desired power factor on his lines. It can be seen by the diagram that it rarely pays to raise the power factor above 90 per cent as the amount of condenser capacity required is very large in proportion to the increase of effective kw. which can be secured.

of air compressors which are to be installed. No doubt one or more other synchronous condensers will be necessary.

The reason why the induction motors are so much too large for their work is primarily found in the fact that the motor voltage is 550, which is an unusual voltage for induction motors, so that it was difficult to find in stock the right size motor for each purpose. The buyers picked up motors where they could find them, often taking a 50-hp. motor where one of 25 hp. would have been sufficient for the load.

From an engineering viewpoint it is much better to buy a motor just large enough for its average load, and if in the future it should be necessary to drive a heavier load, the old motor can be replaced with one of larger rating. Much money can be saved by such practice in the first cost of the motor, the higher efficiencies secured, and from the standpoint of generating and delivering power.

Rubber factories as a rule suffer from poor power factor, caused by many large induction motors running at part loads. It seems reasonable to believe that in the near future synchronous motors will be quite widely used for rubber-mill drive. This will increase the efficiency of the entire plant and remove the necessity for large condensers. Some form of magnetic clutch is necessary both for starting and for safety reasons. Already there are a number of installations of this kind, and synchronous motors are proving their ability to handle the large fluctuating loads on the line shafts in rubber mills.

A certain rubber company obtains a rate from the central station based on a maximum demand of approximately 8000 kw. at a power factor of 90 per cent. Should this power factor drop to 70 per cent, the rubber company is penalized at the rate of $1 per kilowatt per year on the maximum demand for that month. In order to maintain power factor at 90 per cent the company has installed two condenser sets with a rating of 2000 kva. each.

WHEN TO USE A SYNCHRONOUS MOTOR

Wherever a large, constant-speed load is to be driven the very first question asked should be: "Can a synchronous motor be used to drive this load?" If starting and running conditions are such that this is possible, the question ought to be answered in favor of the synchronous motor. The matter should be viewed both from the standpoint of motor efficiency and also from the broader viewpoint of overhead cost for delivering power. Following is a typical case as outlined by a prominent central-station manager.

A centrifugal pump requiring 400 hp. and with a speed of approximately 600 r.p.m. was to be driven by an alternating-current motor. There were to be a number of other smaller motors at this plant. If a 400-hp. induction motor was installed, it was estimated that the average power factor of the load would be 70 per cent lagging. The average power factor of the load with a 400-hp. synchronous motor driving the pump would be over 90 per cent power factor. The comparative efficiency of the two motors was considerably in favor of the synchronous unit.

The following table shows that nearly $14,000 more initial investment* would have been required of the central-station company to serve the load if the 400-hp. induction motor had been installed than was necessary with the synchronous motor installed:

Transformer substation	$430.00
2300-volt service	215.00
13,000-volt distributing system	1,806.00
Step-down substation (50,000 volts to 13,200 volts)	774.00
Transmission lines, 50,000 volts	8,600.00
Step-up transformers, 13,200 volts to 50,000 volts	774.00
Generators	1,290.00
Total	$13,889.00

On a basis of 10 per cent for interest and depreciation this would mean an annual charge of $1,389 against the induction motor when compared with the synchronous motor.

Under the conditions the central-station company absolutely refused to furnish power for this load unless a synchronous motor was used.

The writer recently sent out a questionnaire to many central-station companies furnishing power loads in

*Based on total kilovolt-amperes required with both arrangements.

manufacturing districts, and it was really startling to see how rapidly changes were being made in regard to power-factor regulation.

One large manufacturing company near Chicago which is a large user of power received a bonus for one month of more than $1,300 as a result of maintaining a power factor better than 95 per cent. In contrast to this, a rather small company using power was penalized $1,900 last year for low power factor. It is interesting to note that this concern was operating a motor-generator set consisting of a 150-hp. induction motor driving a direct-current generator. Owing to the fact that the maximum load of the generator was never more than 40 kw. or 50 kw. and generally much less than this, the power factor on this induction motor was very poor. If this had been a synchronous motor of similar rating operated at its full kva. capacity, the power factor of the interior system would have been so raised that there would have been no penalty imposed. Thus in one year's time a saving of $1,900 would have been effected, or more than enough to pay for the motor.

One of the large power companies in Ohio has the following clause in its contract:

> When the current supply is alternating and the greater part of the load is power and the billing demand exceeds 75 kw., the company reserves the right to test the power factor of the consumer's load, and if the average power factor is greater than 75 per cent, then the demand shall be reduced in accordance with the following formula: Billing demand = kilowatt demand as measured ÷ average per cent power factor × 75.
>
> If the average power factor is less than 60 per cent, then the demand shall be increased in accordance with the following formula: Billing demand = kilowatt demand as measured ÷ average per cent power factor × 60.
>
> The company will make without charge a power-factor test at the consumer's request once a year, if his demand exceeds 75 kw. By power factor is meant the average power factor under normal operating conditions.

A number of companies in Illinois operating under the Illinois Public Utilities Commission incorporate the following clause in power contracts:

"Should the power factor fall below 80 per cent, the energy as metered shall, for billing purposes, be subject to an increase in the ratio of 80 per cent to the actual power factor as used."

The following clause is quoted from an Indiana company's contract:

"The primary charges will be increased by 1 per cent for each 1 per cent the power factor on the entire load decreases below 75 per cent at any time."

THIS war is one of nations—not of armies—and all of our 100,000,000 people must be economically and industrially adjusted to war conditions if this nation is to play its full part in the conflict. The problem before us is not primarily a financial problem, but rather a problem of increased production of war essentials and the saving of the materials and the labor necessary for the support and equipment of our army and navy. —*Woodrow Wilson.*

SUDDEN SHORT CIRCUITS OF A.-C. GENERATORS

Mathematical Notes That Supplement the Derivations and Explanations Given in Previous "Electrical World" Articles on This Subject

BY N. S. DIAMANT

FOR the benefit of operating or designing engineers interested in actual quantitative results and detailed derivations regarding sudden short circuits of alternators, the following notes are given:

Derivation of equation (1), ELECTRICAL WORLD, May 18, 1918, page 1028: See footnote (4) and *Transactions A. I. E. E.*, Vol. 34, equations (3), (4) and (5).

Derivation of equations (2) and (3), page 1029, follows from the solution of:

$$Mi_1\sin\omega t + Mi_2\sin[\omega t - (2\pi/3)] + Mi_3\sin[\omega t - (4\pi/3)] + L_f i_f = N_f[\Phi_{fssc} + (\Phi_f - \Phi_{fssc})\varepsilon^{-\alpha_f(t-t_1)}] \quad (10)$$

$$Mi_f\sin\omega t + L_a i_1 = (N_a\Phi_a\sin\omega t)\varepsilon^{-\alpha_a(t-t_1)} \quad (11)$$

and two other expressions similar to (11) for the other phases, where $\omega t = 0$, $\omega t_1 = \theta_1$, i_f = (unknown) field current, i_1, i_2, etc. = (unknown) armature phase currents, α_f, α_a = attenuation factors of field and armature respectively, L, M = self and mutual inductance respectively.

After some algebraic transformations and the substitutions given below, equations (2) and (3) are obtained. $\lambda_f = L_f - (3/2 \times M^2/L_a)$ = total leakage inductance reduced to field.

$N_f\Phi_f = L_f I_f$ = total field flux.

$D = (L_f - \lambda_f)/\lambda_f = (L_a - \lambda_a)/\lambda_a$.

For further details as to the algebraic procedure see May 18 issue, pages 1028-1032, and June 1 issue, pages 1126-1129.

Boucherot's "memoire" should be consulted where single-phase and two-phase alternators are considered. The three-phase sudden short-circuit equations are given by the writer for the first time in the ELECTRICAL WORLD and involve certain assumptions, such as that the mutual inductance between phases is negligible and that the sustained short-circuit armature flux = Φ_{assc}, is zero, etc. The reader will see the reason for these and appreciate their relative importance by going through the mathematical derivation for himself. If $\Phi_{assc} = 0$, i_f is given by (2) as before plus the following terms:

$$-(\lambda_a/M)\{D - D\varepsilon^{-\alpha_a(t-t_1)}\}I_{ssc},$$

which are clearly negligible.

As stated before, single-phase sudden short circuits between line and line or line and neutral present certain peculiarities. Boucherot gives the following equations for the armature and field currents for a machine without amortisseur winding:

$$i_a = I_{ssc}\left[\cos\theta_1\varepsilon^{-\alpha_a(\theta-\theta_1)} - \frac{\cos\theta}{L_f - (L_f - \lambda_f)\cos^2\theta}\left\{\sqrt{L_f\lambda_f} + (L_f - \sqrt{L_f\lambda_f})\varepsilon^{-\alpha_f(\theta-\theta_1)} - (L_f - \lambda_f)\cos\theta\cos\theta_1\varepsilon^{-\alpha_a(\theta-\theta_1)}\right\}\right] \quad (12)$$

$$i_f = \left[\frac{I_f}{L_f - (L_f - \lambda_f)\cos^2\theta_1}\right]\left[\begin{array}{l}\text{Same expression as}\\ \text{in parentheses for } i_a\end{array}\right] \quad (13)$$

Nitrogen Fixation and Conservation of Fuel

A. I. E. E., in Annual Convention at Atlantic City, Also Considers Transmission and Distribution Problems and Protection of Apparatus—Timeliness Is a Characteristic of the Proceedings

TWO subjects which have been made prominent on account of the war—nitrogen fixation and conservation of fuel by utilization of water power—were discussed at the Atlantic City convention of the A. I. E. E. this week. Other subjects that are especially timely in that they bear on the provision of reliable service, the protection of circuits and apparatus and the possibility of getting along without attendants were also considered. All except five of the papers presented are abstracted in this section. Information on the subjects not considered in this issue—aerial cable construction, pre-charged condensers, sustained short-circuit phenomena and automatic operation of hydroelectric plants—has been given in previous issues of the ELECTRICAL WORLD.

AMERICA'S POTENTIAL SUPPLY OF ELECTRICITY

Proposal to Generate Electrical Energy at Source of Supply and to Collect as Well as to Distribute It Electrically

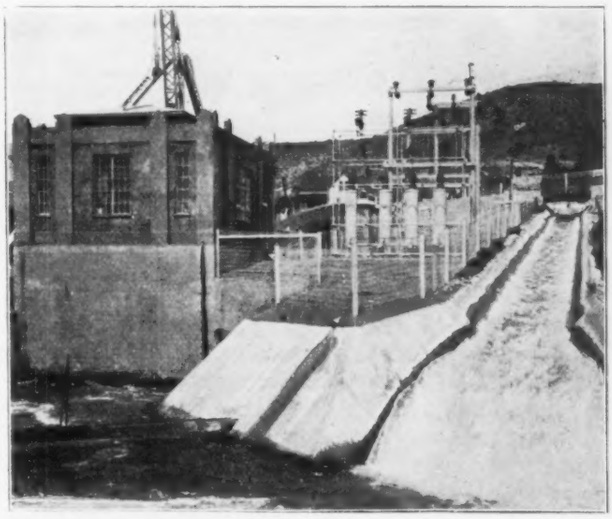
In a timely paper presented at the Atlantic City convention of the A. I. E. E. Dr. Charles P. Steinmetz pointed out the national failure to develop the many small hydraulic power sites and also the extravagant use of fuel for heating purposes. He suggested that the solution of the problem of the economical development of more water powers and waste-steam plants lies in the adoption of the induction generator.

Dr. Steinmetz estimates that the coal requirement is now increasing at the rate of 56,000,000 tons per year and that the demand for 1918 will reach 867,000,000 tons, which represents about 867,000,000 kilowatt-years of energy. Of this total he estimates that 217,000,000 kilowatt-years is actually used. The total hydraulic energy available per year, computed from a study of rainfall between 30 deg. and 50 deg. latitude, is represented by about 380,000,000 kilowatt-years. At 60 per cent efficiency the total potential hydraulic energy usable would be 230,000,000 kilowatt-years, or just about sufficient to supply the national energy requirement for 1918. However, hydraulic energy can never replace coal entirely as a source of energy. This is a strong argument for efficient methods of using coal. A source of energy which is practically unlimited, if it could only be used, is solar radiation. This is probably the great source of energy of the future, about 130,000,000,000 kw. of power in the form of solar heat being available between 30 deg. and 50 deg. latitude.

SIMPLIFICATION OF HYDROELECTRIC PLANTS

The modern hydroelectric plant has become very complicated on account of the many auxilliary devices required for the electrical equipment and is not usually economical for capacities less than 1000 hp. But it is well known that the greater part of the national water-power supply is confined to comparatively small areas at high altitude. In order to utilize these power sites, therefore, it is necessary to devise a simplified hydroelectric plant for capacities below 1000 hp. Some different and very much simpler type of generating station must be evolved before attempting to develop economically these thousands of small hydraulic powers, to collect the power of the mountain streams and creeks.

The hydroelectric station may be greatly simplified by the elimination of the low-tension busbars, making a permanent connection between the generator and transformer. The hydraulic governor may also be omitted from the turbine, permitting the generator unit to run continuously at full load. Finally, the induction generator should be substituted for the synchronous generator now commonly employed. The station thus becomes a comparatively simple one. But it must not be forgotten that the simplicity of the induction-generator



ATTENDANTLESS INDUCTION-GENERATOR PLANT AT NACHES, WASH.

By connecting a number of plants like this together power can be developed from small streams at relatively low cost

station results from the relegation of all the functions of excitation, regulation and control to the main synchronous station of the system. The induction-generator stations thus are feasible only as adjuncts to at least one large synchronous station.

Induction-generator plants may ultimately be made automatic in operation, requiring only occasional attendance and inspection. It should be possible to collect electrical energy from these plants just as energy is now distributed electrically and thus to utilize the great number of water-power sites now unavailable.

Regarding the operation of such an induction-generator set it may be started as an induction motor, and upon admitting water to the wheel the machine speed rises to full-load value. If the set is running at normal full load and the circuit breaker opens, the speed of the set may rise to a value somewhat less than 200 per cent of normal, but, on closing the switch, the speed imme-

diately falls to a point fixed by the power of the water-wheel—slightly above synchronous speed for the induction generator. On the other hand, should the flow of water cease the induction machine slows down to a value slightly below synchronous and continues to revolve as an induction motor. Thus the induction generator lends itself very readily to automatic operation.

With induction-generator operation it is possible that a condition of instability may be encountered. If the generating unit has reached high speed, owing to opening of the circuit breakers, the speed may not fall to the normal full-load value if the turbine torque curve crosses the generator torque line in more than one place. It is very improbable that such a condition would arise in practice, but it should not be overlooked.

Of the hundred million tons of coal burned annually for heating purposes, most is used as steam heat. Dr. Steinmetz proposes to have the multitude of small heating plants develop steam pressures sufficiently high for the insertion of a turbine induction-generator unit in the steam system and thus to generate electrical energy as a by-product. The power would not be generated continuously, but mainly in winter and during the evening. Thus the maximum power generation by such fuel power plants essentially coincides with the lighting peak of the central station. These steam-turbine plants should be made simple and automatic. They might then be connected to the extensive energy collecting lines as in the case of the simplified hydro-electric plants.

ELECTRIC POWER FOR NITROGEN FIXATION

Relative Merits of Direct and Indirect Methods—Combined By-product Coke Ovens, Generating Plant and Nitrate Plant Suggested

In so large a field as that of the nitrogen fixation industry there must necessarily arise numerous improvements in the various processes which make it impossible for any one to forecast their future relative economic values. In the opinion of E. Kilburn Scott, who presented a paper before the A. I. E. E., the merits of the arc process of making nitric acid have not been adequately and sympathetically considered. To show its relative merits he points out that the indirect method involves the manufacture of carbide of calcium and its combination with nitrogen to form calcium cyanamide, from which ammonia, and in turn nitric acid, are obtained. The direct method, however, merely consists of combining nitrogen and oxygen from the air by means of the electric arc. In the direct method electric energy is the only factor, whereas by the indirect method a plant of very diverse and complicated character is required.

As a basic load for a power house the direct arc process presents the advantage that it can be established anywhere, because, the raw materials being only air and water, considerations of transportation do not enter into the situation.

It is particularly suitable for off-peak or off-season loads, for there is no fused material to solidify, and little to deteriorate in case of stoppage. Some of the furnaces can be switched on and off like an arc lamp, without detriment to brickwork or structural details or to the process of manufacture.

Because the plants in Norway are very large and only use hydroelectric power, a belief has grown up, that the arc flame process can only be worked commercially on a very large scale and with water power. As a matter of fact hydroelectric power may be a disadvantage because of its distance from industrial centers, for either the factory has to be placed in an out-of-way position, or else the power has to be transmitted over a long transmission line. The suggestion is made that the plants for making nitrates by the direct arc process should be erected at existing power houses to improve the load factor and reduce costs. By making nitrate in a number of centers its transportation to the explosive factories would be reduced, and the risk of interruption of supplies in case of accident or sabotage would be less than having a few very large factories.

An industrial process capable of furnishing electrical energy as well as a supply of ammonia would be ideal, and it so happens that this is the case with a regenerative coke-oven plant. Half the total gas made is available, and this can be easily turned into electrical energy.

OXIDE-FILM ARRESTER REQUIRES NO ATTENDANCE

Contains Neither Liquid Nor Inflammable Material and Requires No Recharging—Has Been Tested in Actual Service

The development of the aluminum-cell arrester represented a distinct improvement over the older multi-gap arrester, but it requires periodic recharging and contains an electrolyte subject to freezing, thus demanding constant attention. These objections, however, are eliminated in the new oxide-film arrester, which was described at the annual meeting of the A. I. E. E. by Crosby Field and Dr. Charles P. Steinmetz.

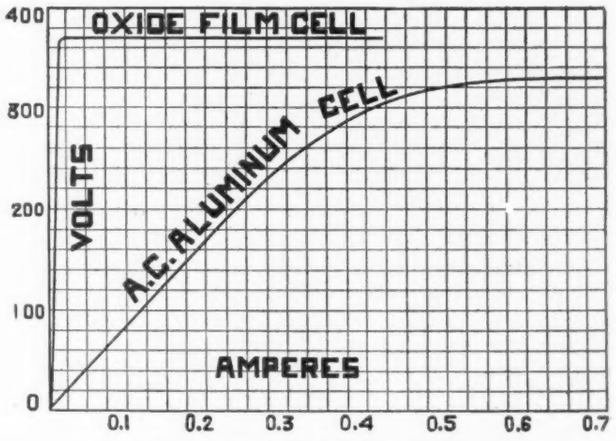


FIG. 1—VOLT-AMPERE CHARACTERISTICS

The oxide film has very small leakage current compared to the aluminum-cell arrester.

The action of the oxide-film arrester depends upon the fact that certain dry chemical compounds can be changed with extreme rapidity from very good conductors of electricity to almost perfect non-conductors by raising the temperature. Lead peroxide may be well utilized because it has a specific resistance of the order of about one ohm per inch cube, depending upon the pressure to which it has been compressed. There

are several other compounds and mixtures of compounds that give the same results as lead peroxide. If these powders are placed between two electrodes and a current passed, the temperature due to the resistance at the contact of the peroxide and the metal will cause the generation of heat locally at the surface. When this heat is sufficient to create a temperature of about

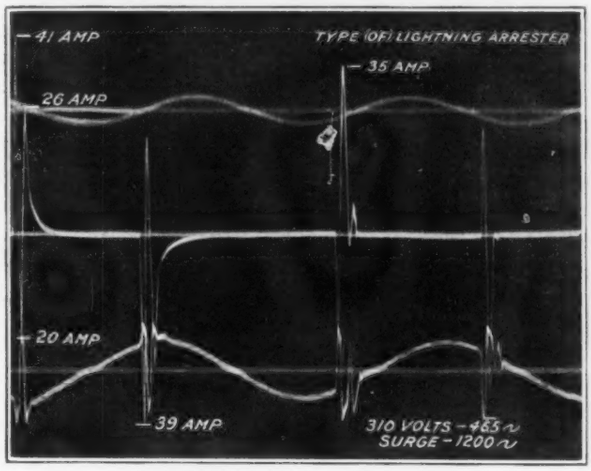


FIG. 2—TRANSFORMER PROTECTED

Top curve — 60-cycle timing wave; middle curve — current through arrester; bottom curve—voltage across the circuit, showing limiting action of oxide-film arrester.

150 deg. C. a film of the lower oxides of lead forms, producing a wall of insulation which stops the current.

This method of film formation over any large area is rather irregular, and the oxide cannot, therefore, be used in such a fashion in the commercial arrester. However, any insulating film may be put on the electrodes initially. Materials such as thin layers of glass, water glass, halowax, cloth, balsam, shellac, oil, paints, lead paints, varnishes and lacquers of all kinds may be used, the only difference being the variation with the voltage at which the puncture of the film of insulation occurs.

The commercial lightning arrester consists of two outside sheet metal electrodes, set about 0.5 in. (12.7 mm.) apart, one or both covered with a thin insulating film and the space between the plates filled with some such substances as lead peroxide. The insulating film prevents any appreciable current flowing at a pressure of 300 volts per cell, but as the pressure rises slightly above normal the film is punctured in one or more microscopic points and the lightning discharge meets with practically no resistance and flows to earth. The dynamic current starts to follow, but because of the fact that the insulation was punctured in such fine points the current density near these points is exceedingly great. This results in a localized heating which speedily raises the temperature to a value sufficient to change all the conducting peroxide to insulating litharge. The film consequently reseals, stopping the further flow of dynamic current.

The film can be made of litharge itself or any of the insulating materials named. Several different kinds of electrodes may be used. The insulating film is best formed by dipping in varnish or lacquer highly burnished surfaces of brass, steel or copper. As the ohmic resistance of the arrester during discharge is low, when the insulating film is punctured the arrester offers very slight impedance to the flow of energy at abnormal voltages.

In all the commercial oxide-film arresters used for alternating current the power factor is nearly unity. For special purposes, however, the power factor can be made anything desired from 10 per cent to unity. This is obtained by combining with the conducting oxide other non-conducting materials.

OPERATION AND TESTS

The oxide-film arrester acts as a counter emf. equal to the normal circuit voltage, freely discharging any over voltage, but holds back the normal machine voltage. Thus the discharge is limited to the energy of the over voltage as in the aluminum arrester, and, like the latter, the oxide-film arrester can continuously discharge recurrent surges, such as arcing grounds, without endangering itself, for a considerable time.

On account of the many disturbances in large electric systems which cannot be completely reproduced in laboratories, the effectiveness and permanence of a lightning arrester cannot be given except by experience in industrial systems. Therefore, after extensive laboratory tests had been satisfactorily completed, the oxide-film arrester was installed in a number of places and has been in successful operation for over three years. It has proved its protective value and its permanence.

Of the tests made on the performance of the arrester it may be sufficient here to give only one, showing the action on a recurrent oscillation. The oscillogram, Fig. 2, was made in the usual manner, a surge or continual oscillation being produced by a large condenser connected to an alternating-current supply and discharging over a spark gap through an inductance. The latter

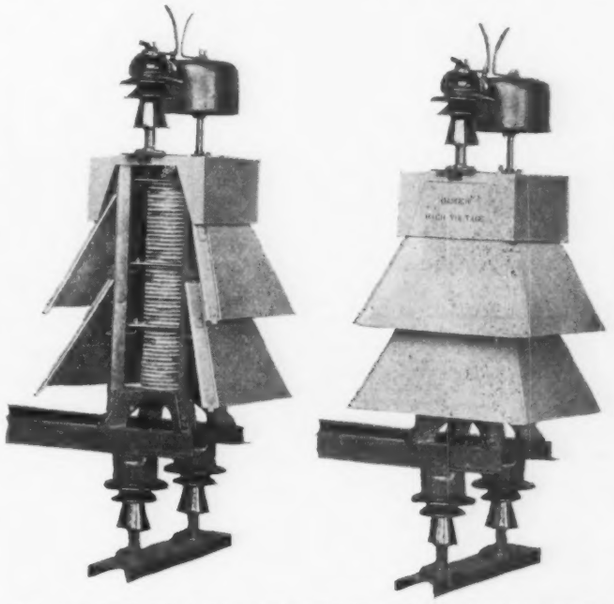


FIG. 3—OXIDE-FILM ARRESTERS EQUIPPED WITH RAIN SHEDS

was chosen so as to give a frequency of 1200 cycles to the oscillation and thereby bring it well within the range of the oscilograph. This surge was impressed upon the apparatus to be protected, a transformer energized by another alternating-current circuit. Fig. 2 indicates conditions with an oxide film shunting the transformer and thereby protecting it. The oscillation

peaks are sharply cut off at a maximum voltage of 60 per cent above the circuit voltage, the value for which the spark was set.

The need of using a spark gap in series with the arrester is the only remaining undesirable feature which the oxide-film arrester shares with the aluminum-cell arrester, the multigap arrester and other types. Against high-frequency disturbances of moderate voltage, however, the only existing protection is the addition to the arrester of a capacity discharge path permanently connected from the circuit to ground. Such capacity path should be without resistance to flatten steep wave fronts and contain a moderate series resistance to dissipate high-frequency energy and stop cumulative oscillations in their beginning. An arrester that would give universal protection should be of the oxide-film or the aluminum-cell type with no spark gap but permanently shunted across the circuit and thus capable of taking care not only of the overvoltages but equally well of steep wave fronts and high-frequency oscillations, even if of lower than the circuit voltage.

IMPULSE PROTECTIVE GAP AN EFFECTIVE APPLIANCE

New Type of "Safety Valve" That Has Auxiliary Electrode Between Horns—Tests Made Give Interesting Results

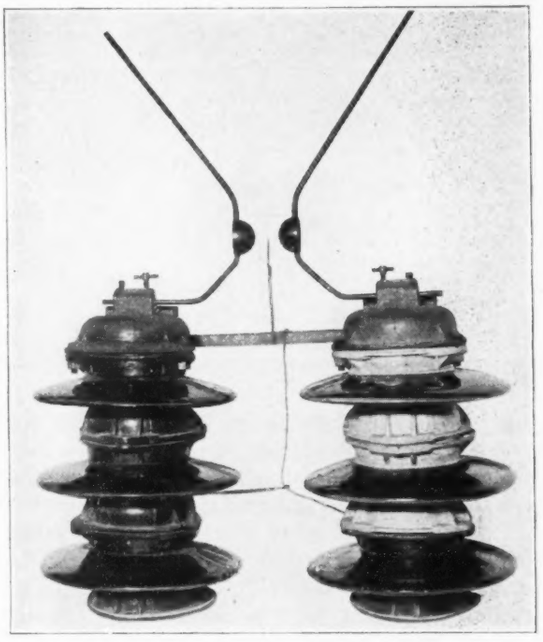
In order to secure adequate protection against line disturbances of steep wave front it is important that a protective gap having the lowest possible impulse ratio be used. A new type of gap which possesses this selective property to a marked degree was described in an A. I. E. E. paper by Chester T. Allcutt. The device is called an "impulse protective gap" because of its particular effectiveness in discharging line disturbances of steep wave front.

In its most elementary form it consists of two gaps in series, each gap being shunted by a relatively high impedance. At line frequency these impedances are proportional to the respective discharge voltages of the gaps which they shunt, but they are designed to change at different rates with changes of frequency. Thus, under the action of a high-frequency impulse, one of the impedances becomes much greater than the other and causes most of the high-frequency voltage to be impressed on one of the gaps. The breakdown of this gap will result in the total voltage being impressed on the remaining gap, which will break down in turn. Commercially, however, it has been found more desirable to have only one gap with an intermediate electrode. A pointed auxiliary electrode gives better results than a spherical or cylindrical one.

Tests on this lightning arrester indicate that the presence of an auxiliary electrode does not appreciably lower the 60-cycle discharge voltage. With the auxiliary electrode in place breaks were somewhat less consistent than with the plain gap, but the irregularities are not of sufficient magnitude to indicate an appreciable lowering of the breakdown voltage. Preliminary tests with impulse voltages to determine the best values for the capacitances and resistances used in the circuits connecting the auxiliary electrode with each horn showed that these two values could be varied through wide limits without affecting the impulse discharge voltage.

In every test made the impulse discharge voltage was less than the 60-cycle breakdown value. With the form of gap having plain horn electrodes the impulse ratio increases rapidly with the larger gap settings, and it will probably become higher than unity for settings in excess of 3 in. (7.6 cm.) When spherical electrodes are used the impulse ratio will remain well under unity even for settings greater than 3 in.

A very great change in the shape of the main electrodes does not affect the impulse discharge voltage to a corresponding degree. However, the shape of the main electrodes will very materially modify the 60-cycle discharge. In view of these facts it is obvious that the lowest impulse ratio will be obtained by so shaping the



AUXILIARY ELECTRODE BETWEEN HORNS IS CONNECTED TO SERIES CIRCUIT OF TWO CONDENSERS AND AN IMPEDANCE BRIDGING GAP

main electrodes as to give the highest possible 60-cycle breakdown voltage. This condition is approximated with spherical electrodes.

Exhaustive tests of the gap have shown it to be superior to the ordinary sphere gap under all conditions. Even under the most unfavorable conditions the new gap gives a high degree of protection.

BALANCED PROTECTION OF CABLE SYSTEMS

Specifications for Split-Conductor Cable—Instantaneous Relays with End Impedances Recommended

Some years ago the Boston Edison company engineers became convinced that line protection devices which function with respect to time, to value of current or to direction of power flow were, in an extensive and rapidly growing transmission network, exceedingly difficult, and frequently impossible, to adjust and maintain in such a relation one to another as to provide for the selective disconnection of any faulty element, without simultaneously permitting the disconnection or shutdown of elements not themselves involved in

the fault. As a result, said W. H. Cole in a paper before the A. I. E. E., it was decided to make use of one or more methods based on the current-balance principle. At first serious consideration was given to the input-output method but this was later abandoned in favor of the balanced-pair method using paired conductors, now quite generally known as "split-conductor" cable. This was done because the balanced-pair method appeared to be less expensive especially when considering duct cost.

SPLIT-CONDUCTOR CABLE SPECIFICATIONS

At the beginning the company was forced to choose between a secondary dielectric of sufficient thickness to withstand successfully at least the star voltage of the system impressed across a dielectric being rapidly weakened by the arc at a fault and a dielectric of minimum safe thickness from a mechanical standpoint but of more than ample value for the normal operating voltage between conductor members. Since the major portion of the secondary dielectric is substantially an idle investment under all normal conditions, it was concluded that any reduction in its thickness with consequent cheapening of the cable is justified, provided a form of protective gear can be devised whereby a failure of the secondary dielectric under any circumstance would not prevent prompt disconnection of the line so affected.

The required form of gear subsequently became available, resulting in the company's standardizing, tentatively at least, a secondary dielectric thickness of 3/64-in. (1.19-mm.) paper for all-around-type, paper-insulated, concentric split conductors for 15,000 volts working pressure; 1/16-in. (1.58-mm.) paper for the same class of conductors for 25,000 volts working pressure, and 5/64-in. (3.96-mm.) paper for both 15,000 volts and 25,000 volts, sector-type, paper-insulated, concentric split conductors. The additional thickness in the sector split type is provided for mechanical reasons.

Owing to the war acceptance of cable not quite up to the pre-war standard has been forced upon users; so more attention has been required in transposing conductors than would usually be necessary in order to secure the desired balance in the completed lines. The Boston company aims to secure impedance balance in completed lines to within one-tenth of 1 per cent. With uniformly well-balanced cable sections this result is ordinarily secured with from one to five transpositions. Its present practice is to use no less than three, dividing the line into four sections.

RELAYS FOR CURRENT-BALANCE PROTECTION

Relays should be instantaneous-overload type, operative on small amounts of energy, hand resetting, and the moving parts should have small inertia. Secondary devices are necessary to close the contacts in the tripping circuit. An auxiliary break in the tripping circuit should be provided to be actuated by the movement of the main switch mechanism. The simple differential transformer is undoubtedly the best device for comparing the currents in the paired conductors.

Since it is absolutely necessary that the scope of the protection shall include the entire line and extremely desirable that line disconnection be effected while the fault current is moderate in value, it is necessary to provide for end-fault protection. This is secured by the use of so-called end-impedance devices, which include the reactive type and the non-reactive type. The three point per pole or split-contact switch is the best known form of non-reactive type. As the relays must not operate on normal differential currents, it is necessary, in order to produce disconnection of the distant end, that the impedance of one of the current paths be altered with respect to the other to the extent necessary to produce a tripping differential current in the balancing transformer at the distant end of the line.

RELATIVE MERITS OF REACTIVE AND NON-REACTIVE TYPES

The choice of end-impedance devices should be governed by the strength of design, space required for their installation, effect on regulation, effect on switch gear and switchboard design, rapidity of action, cost, etc. From the standpoint of strength of design, the balance appears to be in favor of the reactive type, since it has no moving or wearing parts requiring adjustment or renewal. The space requirement usually is a local consideration. The reactive type in some forms has some effect upon voltage regulation. In any form the effect is not serious, particularly when the growing use of current-limiting reactors is considered.

It is obvious that standard types of switches are adequate with reactive schemes of end protection, but the non-reactive type, as embodied in the split-contact switch, requires a special design of switch. For small capacities this may not be a serious matter, but for larger system capacities the necessity of designing the three-point or split-contact switches so that all three breaks per pole have the same breaking capacity means at least 50 per cent more space per pole on account of the additional pot.

On the whole, it appears, considering the rapidity of action, at least on large systems, that the reactive form of end-impedance device has a distinct advantage over the non-reactive type.

ORDINARY PAIRED CABLE

If the ordinary type of overload relay is used with independent paired conductors, their settings might need to be so high as to preclude operation on section faults, or in any event to prevent the obtaining of the maximum benefit of balanced protection.

In order to obviate the necessity of the high relay settings and at the same time to insure non-operation on through short-circuits, relays have been developed both in this country and abroad, variously called "biased relays," "percentage balance relays" and "ratio balance relays."

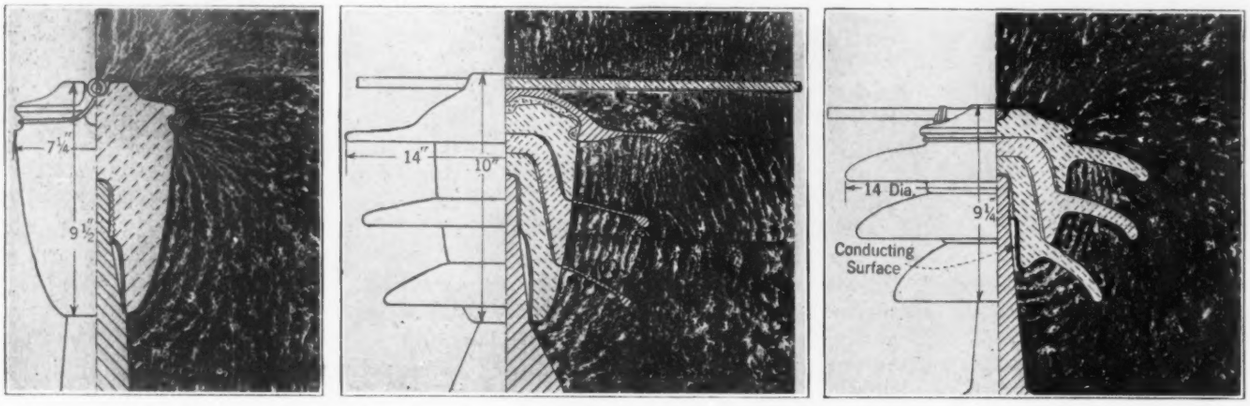
In order to choose correctly the proper winding ratio for ratio balance relays, it is necessary to know what the normal differential current will be under extreme conditions and the percentage it bears to the simultaneous vector sum of the compared currents. Once adjusted for this normal relation, they cannot operate on any value of through current, since the restraining force will then always be in excess of the operating force.

In conclusion, Mr. Cole said: "A sufficient number and variety of actual faults have occurred to demonstrate that full reliance may be placed on the system of protection, provided that the fundamental requirements are met in its design, installation and operation."

DESIGNING INSULATORS FOR BEST FLUX DISTRIBUTION

Electrostatic Field Around Insulators Studied to Give Basis for Constructing More Effective Insulators

The design of an insulator should depend not only upon the practical experience and opinions of operating engineers, but also upon purely theoretical considerations, chiefly distribution of the electric field at abnormal voltages, said G. I. Gilchrest, in a paper read at the recent annual convention of the A. I. E. E. With this in view the author has analyzed the various causes of insulator failure and determined by experimental means the shape that insulators should have to be most effective for given conditions.



DIELECTRIC FIELD AROUND THREE INSULATORS OF RECENT DESIGN

Causes of Insulator Failure

Among the principal causes of pin-type insulator failure he cites the following: Improper distribution of dielectric field and surface leakage; porosity; mechanical breakage, lightning, birds and animals short-circuiting line; unequal expansion of metal, cement and porcelain; internal stresses in materials and defective batches.

To visualize the electric field around insulators Mr. Gilchrest supported the insulators so that the plane of the field to be studied was horizontal. Then a piece of fullerboard was fitted over a half section of the insulator in this plane and asbestos particles were sifted thereon. The particles arranged themselves along the electrostatic flux lines.

From studies of this kind he developed several new shapes of insulators, for which the following advantages are claimed:

1. When the insulator is dry the corona and static formations are practically limited to the tie wire and line wire up to flashover voltage.
2. When the insulator is wet no corona or static formation occurs up to flashover voltage. The flashover voltages for given over-all dimensions are thereby increased.
3. The leakage resistance per shell is increased gradually from the head to the center shell. This takes into account the probability of the lower sheds becoming dirtier than the tops. The voltage distribution per shell is, therefore, equal when the insulator becomes dirty and wet and a heavy leakage current passes over the insulator.
4. Since the capacity per shell is about constant, the voltage distribution per shell will be uniform when the insulator is clean and in dry air.
5. Since the distribution of voltage per shell depends upon the capacity current and leakage current, the distribution of voltage per shell in these designs should be approximately uniform under all operating conditions.
6. The resistance of the insulator to side pull for a given weight and given electrical strength is relatively high. This is due to the feature of the design whereby the flow lines of the electrostatic field and the mechanical stress lines coincide.
7. The design of the individual shells is such that when they are tested before assembly the surface conforms to the electrostatic flow lines. This allows the testing of the individual parts to a higher percentage of service voltage than was possible in case of the individual shells of the older designs.
8. Owing to the shape of individual parts and of the assembled unit, the insulator sheds when hit by stones, rifle balls, etc., break only to a limited extent. The unit, therefore, offers a considerable percentage of its original resistance to flashover after the sheds are broken. The same feature tends to protect the insulator from complete failure during the flashover in service.
9. Each characteristic of the insulator which would vitally affect durability in service has been treated uniformly throughout the line.

PREVENTING FLASHOVER AT COMMUTATOR AND BRUSHES

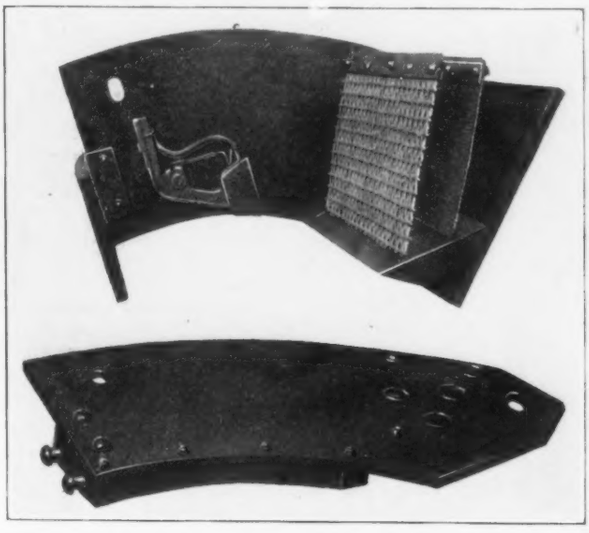
Use of Screen Barriers Between Brushes and Provision of High-Speed Circuit Breakers Effective with Direct-Current Machines

Any means for preventing flashing at the commutator and brushes of direct-current machines must operate very quickly if it is to be effective, said J. J. Linebaugh and J. L. Burnham in their paper before the A. I. E. E. convention. This requirement is met to a great extent by using high-speed circuit breakers or barriers between brushes, but complete protection requires both. The cause of flashover may be reduced by providing magnetic fields of proper strength and distribution to influence the coils during commutation.

With special high-speed circuit-opening devices operating in about 0.005 second, the more sensitive machines, such as 60-cycle synchronous converters, may be short-circuited without flashing over, even though the maximum current is of higher value than would cause flashing with suddenly applied load and ordinary circuit-breaker protection. The speed at which a current breaker must operate to prevent flashing depends on the amount of load through the machine, but tests indicate that, under the worst conditions, it must be quicker than one half cycle of the machine to be protected.

One type of circuit breaker which has been found specially suitable is being used on the Chicago, Milwaukee & St. Paul Railway. It has a laminated contactor which is held closed by an electric holding coil. When the load becomes excessive the current through a series bucking coil offsets the magnetic flux of the holding coil, allowing a spring to separate the contacts.

Automatic substations at Des Moines, Iowa; Columbus, Ohio, and Montieth Junction, Mich., are using barriers which have been found very effective in preventing flashover between brushes. A close-fitting box of fireproof insulating material surrounds each set of brushes and is placed so as to give a small clearance between the box and the commutator. On the side of the box toward which the commutator rotates after leaving the brush a V-shaped "scoop" of fireproof in-



SCREENS AND SCOOPS AT LEFT COOL AND DIVERT ARCS PRODUCED BY FLASHING BRUSHES

sulating material is fastened, preferably having good heat conductivity, pointing toward the brush and having small running clearance from the commutator.

Radially above the scoop, about 1 in. (2.54 cm.) apart, are two metal screens, one coarse and one fine mesh, through which the arc is successively forced and cooled.

TRANSPOSITION OF PARALLEL POWER AND TELEPHONE LINES

"Exposed Line" System Most Important Remedy for Inductive Effect—Limitations of Two Methods Devised

"Of all the means used to reduce the inductive effect between power and telephone circuits the co-ordinate transposition of both classes of circuits is probably the most important," said Harold S. Osborne in a paper before the A. I. E. E. His method has been carefully investigated in California by the joint committee on inductive interference, with the result that a method known as the "exposed-line transposition system" has been developed. Two designs have been completed, called the E and L sections. The first is for a maximum length of 12.8 km. (7.9 miles), the other is best for less than 6.4 km. (3.9 miles).

The E section can be used to co-ordinate with transpositions in three-phase power circuits which create for the maximum length of E section 0.8 km. ($\frac{1}{2}$ mile), 4.8 km. (3 miles) or 9.6 km. (6 miles) in the power circuit. It was found possible to design the L section so that it balances a three-phase power line transposed at the quarter-section points.

The exposed line transposition system has been designed primarily for use on toll lines and not for use on joint lines with power distribution circuits.

When large inductive effects are experienced from circuits less than 20 ft. (6 m.) away from a side circuit, the variation in separation between the telephone circuit and the exposing circuits as the side circuit shifts from one pair of pin positions to another must be taken into consideration. The E section is not designed to give a high degree of balance under this condition for all circuits in each eighth section, but does give balance to uniform outside induction effects for most circuits in each eighth section and, with one exception, for all circuits in each half section. Under similar conditions the L section gives a balance for most circuits in each quarter section and for all circuits in each half section.

It should be clearly understood in the use of the telephone transposition sections that it is important to co-ordinate the transpositions in the telephone lines both as regards relative length and as regards relative location of telephone transposition section and transpositions in the power circuits.

REACTANCE OF ALTERNATORS AND ITS APPLICATIONS

Simple Method of Predetermining Reactance Which Is Applicable to Wide Range of Synchronous Machines

The calculation of initial short-circuit currents of synchronous machines may be satisfactorily worked out from design data provided that the constants of the machine can be predicted with reasonable accuracy. A method of predetermining armature reactance applicable to a wide range of synchronous machines has been worked out by R. E. Doherty and O. E. Shirley and was fully explained in a paper presented at the annual convention of the A. I. E. E. The complete scope of the paper may be summarized as follows:

1. To present a reliable, general method of obtaining armature reactance of synchronous machines.

2. To give a simplified general equation, in accordance with standard construction, which will enable the designer to calculate armature reactance quickly by the use of curves and design data sheets.

3. To derive a formula for the calculation of field inductance which is used in the calculation of initial short-circuit currents and to explain the physical phenomena occurring at short circuit.

4. To derive an expression for accurate calculation of armature reaction, taking into account the effect of field distribution.

5. To show the effect of harmonics in the no-load field-flux wave on the field excitation under load.

6. To give a simplified method of calculating field excitation, using armature reactance value previously determined.

"The Engineer Is the Hope of the Nation"

E. W. Rice, Jr., Retiring President of the American Institute of Electrical Engineers, Addressing the Atlantic City Convention, Makes Clear the Part of Engineering in the War

THE vital importance of revising or further extending the activities of the A. I. E. E. so as to help in a speedy winning of the war, and the necessity of looking ahead to the solution of engineering problems which will be involved in the reconstruction work after the war, were important subjects dwelt on at the annual convention of the A. I. E. E. held at Atlantic City on Wednesday, Thursday and Friday of this week.

Address of President E. W. Rice, Jr.

Mr. Rice, in outlining the value of the Institute, said:

"The engineer is the hope of the nation, not only now, when we are at war, but even more so in the future in the days of reconstruction following the great peace. The engineer may perform valuable service when working alone, but his usefulness and power is manifestly greatly increased when acting in co-operation with thousands of his brothers.

"The Institute is not only a democracy, but is a democracy of educated men, and such men have a heavy responsibility to society at present and in the future. They should be leaders and exemplars for those who have not been so fortunate as to have enjoyed their opportunities. The Institute needs its members and the members need the Institute, that the electrical engineer may fulfill his high destiny."

There has been no material improvement for several years in electrical units such as dynamos, motors, transformers, etc., said Mr. Rice. In the field of thermodynamic engines, represented largely by the steam turbo-generator unit, some improvement has been obtained. While not large, this is doubly important because of the great increase in the cost of fuel. He added:

"Concurrently with this improvement in the turbo-electric machines, great advances have been made in the design and operation of the steam-producing devices—the boilers, auxiliaries and other features of the modern power station. As a result the thermal efficiency has been rapidly improved. The steam turbo-electric unit has not reached its limit of thermal efficiency."

Progress has been made and is still possible in the generation, transmission and utilization of electrical energy.

"Improvement has been effected," said Mr. Rice, "not only by changes in designs of the units themselves, but also by their method of use, based upon the recognition of the fact that the elimination or reduction of the losses at light load will greatly improve the total efficiency, especially when the time of use of the apparatus under load is a small part of the total time.

"It has been estimated, and it seems a conservative estimate, that through the saving in reserve equipment, improvement in load factor and the diversity of different loads, the useful output of groups of large systems may through interconnection be increased about 25 per cent."

The standardization committee has been of inestimable value to the profession and to the industry, Mr. Rice said. "As a result of its work the cost of electrical apparatus to the consumer has been greatly reduced over a number of years and the quality has not been sacrificed but has been improved."

President Rice then referred to the growth of 60-cycle systems, which it is now estimated represent about 70 per cent of the total power supplied in the country. This standardization will hasten the time when a network of the transmission lines, fed by superpower stations, will cover the country.

Reference was made by Mr. Rice to the marked advance in electric furnaces. It is estimated that the number of these in the United States has increased about 40 per cent in the last year and that there are now in operation over five times those of five years ago.

On the work of the electrical engineer in the war Mr. Rice said:

> Electrical engineers have been devoting much time to the solution of many war problems. It is not desirable or possible to review such work at present, but when the veil is lifted we shall all be gratified with the result. We must content ourselves with the mere statement that this work has covered means for the detection of the pirate submarine, wireless signaling and telephoning for army and navy and aircraft devices, searchlights of novel design and great power, improved methods in manufacture of ammunition and ordnance, electrochemical work of every description, electric welding, X-ray sets of greater simplicity and accuracy, and many other lines too numerous even to mention. . . . I hope that the time will come when the story may be told, so that the world may realize the debt which it owes to scientific men and engineers, without whose arduous, unselfish and almost inspired work our cause, righteous as it is, would have no chance of a victorious conclusion.

Mr. Rice reverted to his remarks at the midwinter convention on the importance of railroad electrification. In concluding he outlined the essential place of electric power in the war program. The power to operate the war industries, in view of its great economy and flexibility, must be electrical. He continued:

> While this country was fortunate in having available a magnificent system of power stations, so great was the magnitude of the demand for increased power created by the war industries that it is estimated there will be a shortage of at least 500,000 kw. of electric power in the Eastern district.
>
> It is vitally important that the great electrical power-producing companies of this country should be helped in every way to meet the heavy demand which is placed upon them, as it has been demonstrated that the quickest, most efficient and altogether best way to meet the demand for power is through the expansion of such existing organizations and installations.

In presenting the president-elect Mr. Rice referred to the fortunate combination of thorough acquaintance with theory and equal familiarity with practice which Professor Adams possesses. Mr. Rice added that his confidence in the future achievements of the Institute was increased by Professor Adams' election to the presidency.

REMARKS OF PRESIDENT-ELECT COMFORT A. ADAMS

Professor Adams, in responding, said that these are not normal times and that Institute proceedings cannot be conducted in the usual way. While he hesitated about suggesting any definite directions along which the Institute activities should be carried, he expressed the opinion that the chief thing to consider now is how the Institute can help in a speedy winning of the war, or, looking ahead, the Institute might consider how to cope with the engineering problems which will be imposed during the reconstruction period after the war. Owing to the rapid revolutionary changes in economic conditions and international relations which the war is forcing, engineers will be more interdependent than ever before in facing new problems. As a result there will be need of co-operative effort among the broadest-gaged engineers of the widest vision. In closing, Professor Adams expressed great optimism regarding the future.

REPORTS OF COMMITTEES

N. W. Storer, chairman of the traction and transportation committee, called attention to the fact that many trunk lines have practically collapsed under war conditions but that electrified lines have not suffered so greatly. Street railways have likewise been hard hit.

Prof. Alexander Gray, chairman of the committee on electrical machinery, suggested that it might be advisable for the committee to serve as a clearing house for suggested changes in standardization rules.

Edward P. Hyde, chairman of the lighting and illumination committee, gave a brief summary of progress in electric illumination, referring particularly to protective lighting and motion-picture projection.

L. E. Imlay, chairman of the committee on transmission and distribution, cited instances of past work and recommended further investigation of insulator problems and electric loss in cables.

Francis A. J. Fitzgerald, chairman of the electrochemistry and electrometallurgy committee, suggested co-operation with the American Electrochemical Society and intense study of hydroelectric development.

A. G. Pierce, chairman of the industrial and domestic power committee, called attention to the tabulation of technical data regarding industrial applications which it has been making and suggested that the committee be broadened or that a new committee be formed to handle the work. This is now of enormous proportions.

Prof. Frederick Bedell, chairman of the committee on electrophysics, urged that steps be taken to maintain adequate teaching staffs to insure continuous output of technically trained men.

D. W. Roper, chairman of the protective devices committee, recommended that an investigation of lightning arresters and protective devices for tie lines be pushed to a conclusion and that relay nomenclature and ratings of circuit breakers be standardized.

K. A. Pauly, chairman of the committee on application of electricity to mines, urged co-operation with the American Institute of Mining Engineers.

S. G. Rhodes, chairman of the instruments and measurements committee, stated that no new development work along purely commercial lines is being undertaken by manufacturers.

Prof. Ernest J. Berg, chairman of the educational committee, presented a synopsis of electrical engineering courses in various colleges and suggested how some colleges might better them.

H. A. Hornor, chairman of the marine committee, called attention to the proposed use of oil-engine-driven generators and motors for ship propulsion and urged closer co-ordination of the work of the various committees.

The subject of education was discussed at length by Prof. W. I. Slichter, Dr. C. P. Steinmetz, Prof. V. Karapetoff, W. L. Upson, Prof. Samuel Sheldon and N. A. Carle. Among the principal points brought out were the possibility of developing personality, the psychology of successful education, the need of "punch" and natural ability to supplement education, the importance of inspirational power in instructors, the fact that colleges attempt to teach too many or unnecessary subjects, and the need of transferring credit from manufacturer to central station or vice versa for education secured in cadet courses.

WEDNESDAY AFTERNOON SESSION

On Wednesday afternoon the following papers were presented: "Split-Conductor Cables—Balanced Protection," by W. H. Cole; "Overhead Cables," by E. B. Meyer, and "The Applications of Theory and Practice of Transmission Systems," by G. I. Gilchrest. Abstracts of Messrs. Cole and Gilchrest's papers will be found on pages 1371 and 1372.

Among those who took part in the discussion of balanced protection were P. M. Lincoln, E. B. Meyer, J. R. Craighead and O. C. Traver. In these discussions it was said that split conductor cable can be made for 7 to 10 per cent more than ordinary cable when used more extensively, but that cost should not be a major consideration. The points cost 10 to 15 per cent more. Several agreed that the carrying capacity is not reduced by the construction. Mr. Traver said that one large operating company could release $1,000,000 worth of cable by operating its system in parallel, a practice permitted with balanced protection.

Considering the use of aerial cable, several speakers called attention to the possibility of the sun's rays limiting the rating of aerial cable if the outer covering is dark. Unequal expansion of the cable and messenger wire might cause separation of the points, it was said, although Mr. Meyer maintained that no trouble had been experienced from this cause. The rating of other circuits in series also limits the carrying capacity of the cable. Among those who took part in the discussion were W. A. Delmar, J. B. Taylor, Philip Torchio and J. A. Johnson.

In the discussion of insulator problems Prof. C. F. Scott emphasized the necessity of studying the electrostatic field around insulators in developing efficient designs and suggested that higher voltage lines might be supported on pin insulators if the design suggested by Mr. Gilchrest gives the results expected. Prof. V. Karapetoff explained how electrostatic flux can be studied with molten paraffine and lycopodium seeds after allowing the paraffine to harden. L. W. Chubb pointed out that it is not necessary to consider refraction of electrostatic flux if insulators are properly designed. Mr. Gilchrest closed by saying that pin-type insulators of the type he mentioned in his paper are being considered for 110,000-volt lines.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

BRAZING PIPE JOINTS TO STOP STEAM LEAKS

This Method Found Especially Satisfactory for Small Connections Needed to Unite Measuring Instruments—Eliminates Inaccuracies

One of the jobs that require careful attention when steam-measuring instruments are being installed is that of connecting the joints in the small pipes leading from the steam mains to the instruments. Many companies which are now installing boiler-room instruments so as to obtain an accurate check on the efficient use of coal discover that unless their pipes are carefully installed they are liable to become leaky at the joints. The Iowa Railway & Light Company of Cedar Rapids, Ia., when it installed additional instruments in its steam plant brazed all of the joints in the small connecting pipes with the effect that no trouble has been encountered and that the instruments give correct readings.

DETERMINING LABOR COSTS OF POLE LINE EXTENSIONS

Advisability of Extending Line to Consumer Decided Upon by Method That Is Applicable Regardless of Prevailing Prices of Labor

BY A. G. DRURY

In order to find out if it will pay to supply a prospective consumer with electric energy it is always well to determine beforehand the cost of material and labor. The labor cost has risen to such an extent recently that the old methods of estimating this cost have grown obsolete. A rule that can be applied at any time is one that uses the man-hour as a basis of cost—that is, the number of men multiplied by the hours they work. This figure may be multiplied by the prevailing wage.

From a study of the time required to perform various line construction operations the author has concluded that the following units are conservative for checking estimates: Loading and unloading one pole, 2 man-hours; haulage per mile, 15 man-hours; digging and setting one 35-ft. (10.6 m.) wood pole, 4 man-hours; equipping one four-pin cross-arm with pins and insulator and attaching to pole, 2.5 man-hours; stringing and tying 100 ft. (30.4 m.) of conductor to insulators, 2 man-hours.

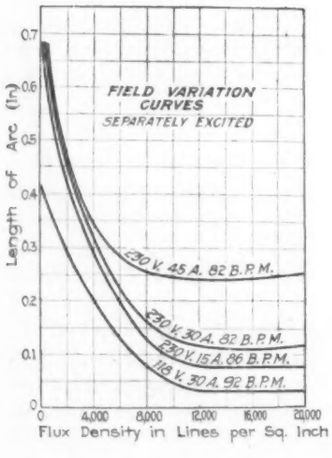
While the time required for the different items of construction may seem liberal, consideration must be given to the fact that some time is lost both at starting and afterward.

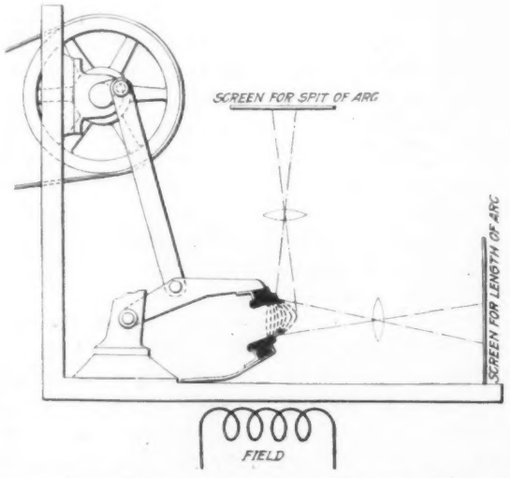
EFFECT OF MAGNETIC FIELD ON CIRCUIT-BREAKER ARC

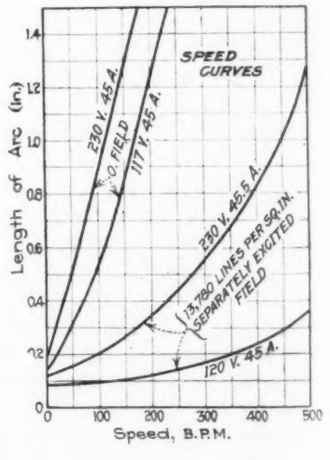
Apparatus Designed to Reproduce Action of Opening Circuit Breaker and to Determine Density and Length of Arc in Varying Field

BY A. M. HOLCOMB*

To determine definitely the values of the density, length, etc., of the arc occurring when a circuit breaker is opened, some means must be worked out whereby the properties of the arc may be observed. The apparatus developed for this purpose, which is shown in Fig. 2, consists of two carbon contacts so linked that they can be steadily opened and closed by means of a belt-driven pulley. Two lenses and screens are placed so that the image of the "split" and length of the arc will be projected on screens. They can then be measured and the actual length calculated. Calibrated field poles were placed near the arc with their current controlled by a rheostat.


FIELD VARIATION CURVES
SEPARATELY EXCITED
Length of Arc (In.)
230 V. 45 A. 82 B.P.M.
230 V. 30 A. 82 B.P.M.
230 V. 15 A. 86 B.P.M.
118 V. 30 A. 92 B.P.M.
Flux Density in Lines per Sq. Inch





FIGS. 1, 2 AND 3—APPARATUS FOR STUDYING EFFECT OF MAGNETIC FIELD ON CIRCUIT-BREAKER ARC, WITH RESULTS OF A TEST

*Extract from thesis by Shetler and Gartla, Case School of Applied Science, Cleveland, Ohio.

Non-inductive loads were used in making the tests, the results of which are shown in Figs. 1 and 3. The former curve shows the effect of varying the field strength when the breaker is operating at a steady speed. The curves of Fig. 3 show the effect of opening the breaker at different speeds. The current was left on for only one or two contacts so that the contacts would not become red and the gap filled with conductive vapor.

By referring to Fig. 1 it may be seen that the arc length varies indirectly as the voltage, current and field strength, but no benefit is obtained by increasing the field strength beyond 12,000 lines per square inch. The gap chamber was comparatively open, and the noise of break at low densities sounded like a slight puff, whereas at high densities there was a slight bark. As nothing resembling an explosion occurred, there is no disadvantage in having a magnetic blow-out.

The results plotted in Fig. 3 illustrate the fact that no advantage is obtained by opening the breaker quickly. The tests do not show excessive or short-circuit conditions, but depict only the effects on the magnetic field when the breaking occurs on moderate overloads.

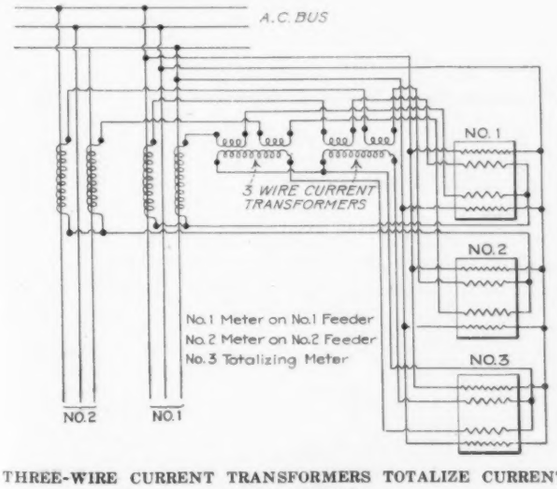
ADDING ENERGY CONSUMPTION OF TWO SEPARATE SERVICES

Three-Wire Transformer Interposed in Current-Coil Circuit of Individual Meters Used as Means of Measuring Energy Collectively

BY JOSEPH N. McCLURG

Foreman Meter Department, Scranton (Pa.) Electric Company

The total energy of two or more services that cannot be tied together may be conveniently determined by the method shown in the accompanying illustration. This system can be used advantageously when the consumer wishes to know the cost of serving each of several plants whereas the company is interested only in the total energy consumed.



THREE-WIRE CURRENT TRANSFORMERS TOTALIZE CURRENT IN TWO SERVICES

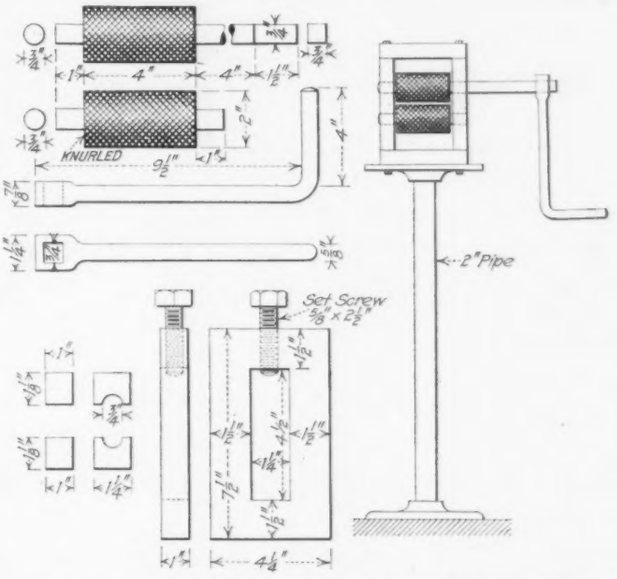
The service meters for each plant are connected in the ordinary manner except that three-wire transformers are interposed in the current-coil circuits. The primaries of each leg of the transformers are connected in the same phase. The secondaries of both of these transformers are connected in multiple with the current coils of the totalizing meter, and therefore the meter will record the total energy consumed by the two distribution systems. The potential coils are connected in the ordinary manner.

METHOD OF FLATTENING LEADS FOR ARMATURES

Inexpensive Tool Provides Efficient and Quick Means for Shaping Conductors to Enter Commutator Lugs

BY FRANK HUSKINSON

Flattening copper wire without producing the hardness or brittleness usually caused by hammering the leads can be accomplished by the machine shown in the accompanying illustration. The device consists simply



MACHINE HAS SMALLER NUMBER OF PARTS AND CAN BE EASILY MADE IN THE SHOP

of two knurled rolls mounted on an iron stand. The copper lead is inserted between the holes and the handle is turned, thus drawing the lead between them and flattening it. The machine is inexpensive to make and is portable, so that it may be placed near the armature.

SPONGE-FELT INSULATION FOR STEAM LINES PROVES VALUE

Formation of Icicles on Pipe in Winter Indicated that Its Exterior Was Not Heated Appreciably by Radiation

A 2200-ft. (670-m.) length of outdoor pipe line 6 in. (15 cm.) in diameter transmitting steam having a temperature of 466 deg. Fahr. has been sucessfully insulated from the low temperature during the winter months by a combination of sponge and hair felt. The sponge is placed next to the pipe and covered with the hair felt. The hair felt will not withstand high temperature but makes an excellent intermediate or superficial covering. The total thickness of the heat insulation on this line is 3 in. (7.6 cm.), and tests show that the outside temperature is only slightly above that of the air with the latter at 22 deg. Fahr. In the winter icicles formed on the line.

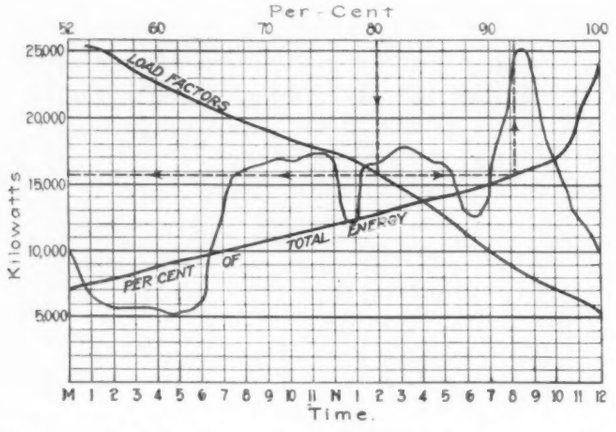
CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

LOAD-FACTOR BASIS FOR PURCHASING ELECTRICITY

Analysis of Central-Station Load Curve Made to Determine the Best Conditions for Buying Energy

A form of analysis of central-station load curves which may be useful in certain computations indicates the load factor of the energy block below any limiting



LOAD CURVE DRAWN TO PERMIT ANALYZING CONDITIONS THAT SURROUND PURCHASE OF ENERGY

kilowatt load and the proportion of the total energy which the block below the limit represents.

Assume that a central station is considering the purchase of energy from a hydroelectric transmission company on a load-factor basis and that to obtain a permissible rate necessitates purchase at a load factor higher than the natural load factor of the system. In other words, a certain amount of energy during peak-load hours must be generated by steam. An average daily load curve is drawn in the usual way. Successive peaks are cut away (presumed to be transferred to the steam plant), and the load factor and quantity of energy in the remaining block are plotted against kilowatts in the manner indicated.

RELATION OF LOAD FACTOR TO PURCHASE OF ENERGY

Limiting Kw.	Kw.-Hr. Above Limit	Kw.-Hr. Below Limit	Load Factor	Per Cent Below Limit
25,300	0	326,900	53.8	100.0
25,000	190	326,710	55.0	99.9
24,000	670	326,230	56.7	99.8
23,000	1,540	325,360	58.9	99.5
22,000	2,780	324,120	61.5	99.1
21,000	4,510	322,390	64.2	98.6
20,000	5,660	321,240	66.9	98.3
19,000	7,010	319,890	70.1	97.9
18,000	9,020	317,880	73.5	97.2
17,000	12,690	314,210	77.0	96.1
16,000	22,180	304,720	79.4	93.2
15,000	33,100	293,800	81.5	89.8
14,000	46,900	280,000	83.3	85.6
13,000	61,300	265,600	85.0	81.1
12,000	76,900	250,000	86.8	76.5
11,000	93,600	233,300	88.4	71.4
10,000	111,000	215,900	90.0	66.0
9,000	128,900	198,000	91.7	60.6
8,000	146,800	180,100	93.8	55.1
7,000	165,000	161,900	96.3	49.5
6,000	184,200	142,700	99.1	43.7
5,100	204,500	122,400	100.0	37.4

For instance, with the load curve shown, to purchase energy on an 80 per cent load factor basis all peaks above 15,700 kw. must be carried by the steam plant; 92.4 per cent of the energy will be purchased and the remaining 7.6 per cent steam-generated. The curves are computed in a simple manner as indicated in the tabulation. Areas of the peak, or series of peaks, above each 1000-kw. line are measured by means of a planimeter, or by counting squares on cross-section paper, and translated into kilowatts, as indicated in the second column. The area above the line is taken rather than that below, as the former is smaller and may be determined with less liability of error. It is ordinarily best to measure by 1000-kw. zones and to take the summation of the zones above each limit. The kilowatt-hours represented by the integration of the curve below each limit are then determined by subtraction from the total (column 3) and the load factor (column 4) by the usual formula.

This form of analysis is particularly necessary where a rate of the following general form is offered:

ASSUMED VARIATION OF RATE WITH LOAD FACTOR

Load Factor, per Cent	Rate per Kw.-hr.	Load Factor, per Cent	Rate per Kw.-hr.
60 to 64.9	$0.008	80 to 84.9	$0.006
65 to 69.9	0.0075	85 to 89.9	0.0057
70 to 74.9	0.007	90 or over	0.0055
75 to 79.9	0.0065		

Assume that peak-load energy can be generated by steam at $0.01 per kilowatt-hour. We may pick off from the curve the percentages purchased and generated by steam for each rate and load factor offered, and from these readily determine the following average costs per kilowatt-hour:

VARIATION OF UNIT COST WITH LOAD FACTOR

Load Factor, per Cent	Average Cost per Kw.-hr.	Load Factor, per Cent	Average Cost per Kw.-hr.
60	$0.00801	80	$0.00631
65	0.00753	85	0.00651
70	0.00706	90	0.00703
75	0.00661		

From which it is evident that purchase on an 80 per cent load factor is most advantageous for the particular set of costs and shape of load curve that have been under review.

EFFECT OF APPLIANCE LOAD IN SPARSELY SETTLED DISTRICT

Appliance Load Rather than Lamp Load as Controlling Factor in Establishing Maximum Demand in Outlying Residential District

In some residential sections served by the St. Joseph (Mo.) Railway, Light, Heat & Power Company only a 2-kw. transformer is justified from calculations based on the number of sockets or number of lamps served. However, it has been noticed in such districts that on Mondays and Tuesdays the trouble department answers a large number of complaints caused by blown transformer fuses.

This is taken to indicate that the load produced by the labor-saving appliances, such as washing machines and electric flatirons, is considerably in excess of any peak lighting load that may come on a transformer. To eliminate the necessity of such frequent trouble calls over-fusing is sometimes resorted to. These conditions are met with in the sparsely settled parts of the outlying residential district of the city.

TRADE ACCEPTANCE HELPS CENTRAL-STATION BUSINESS

Under Plan Worked Out at Columbus Contractor and Manufacturer Finance 50 per Cent of Sales of House Wiring and Appliances

In the latter part of last year the Columbus (Ohio) Railway, Power & Light Company discontinued the sale of electrical appliances and the wiring of old houses on the partial-payment plan. The matter was considered for a month or six weeks, and at that time it was decided to continue as before, but finally the condition became such that the management issued an order to stop such sales, and this order was immediately put into effect.

As a real new-business department does not enjoy having its means of doing business eliminated, Mr. W. A. Wolls, new-business manager, said before the commercial men of the Ohio Electric Light Association, his department at once set about to find ways and means whereby it could again produce business for the company. Upon investigation it was found that the trade-acceptance plan of financing would meet the requirements. Inasmuch as the company enjoyed the best of co-operation with the electrical jobbers and contractors, a plan for the wiring of old houses was submitted to them whereby the company would give to the contractor a contract to wire a house and on completion of the work would present his bill to the company with a trade acceptance attached ready for the signature of an authorized officer of the company. This trade acceptance would be returned to the contractor. The trade acceptance is made payable in 120 days. The contractor discounts the trade acceptance with his bank at the rate of 6 per cent per annum, whereas formerly the company would discount all bills at 2 per cent for cash. The contractor's revenue for the work done is exactly the same as it was before the use of the trade acceptance. This plan has been in successful operation for the last two months.

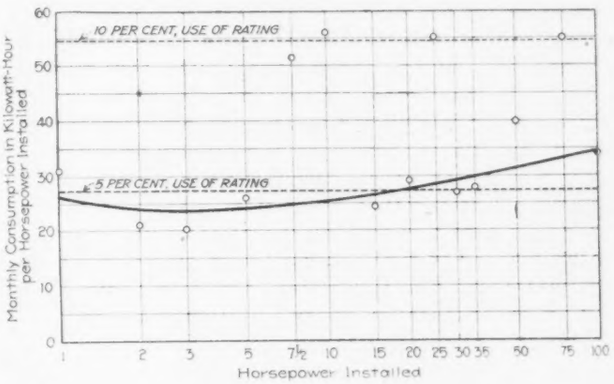
In regard to the sale of electrical appliances on the partial-payment plan, the company, Mr. Wolls stated, formerly sold appliances on the basis of 10 per cent down and the balance in ten equal monthly installments. The company has now arranged with the customer a new basis of approximately 25 per cent down and the balance in six equal monthly payments; and with the manufacturers of the larger appliances, such as washing and ironing machines and vacuum cleaners, a basis whereby they accept in payment trade acceptances payable one-third in 60 days, the balance in 90 and 120 days.

Under the foregoing arrangement the wiring of houses and the sale of appliances is done on the basis of 50 per cent, financed by the electrical contractor and the manufacturers of appliances and 50 per cent by the company. This plan, Mr. Wolls states, is a war-time necessity.

AVERAGE SMALL-MOTOR ENERGY CONSUMPTIONS

Majority of Groups Used Approximately 25 Kw.-Hr. per Connected Horsepower, or About 5 per Cent Use of Rating

A Western central station recently analyzed the energy consumptions of its smaller power customers in order to determine the incomes which might be expected from future extensions. The customers were grouped by connected load, and the consumptions for each group were tabulated for a number of months. It is interesting to note that the majority of groups consumed approximately 25 kw.-hr. per horsepower connected per month, or about 5 per cent use of rating. The remainder consumed close to 55 kw.-hr. per horsepower per month. The latter figures were probably caused by a few customers of high load factor.



ENERGY CONSUMPTIONS OF SMALL POWER CUSTOMERS

Nominal Hp.	Limits	Horsepower Months	Kw.-hr. Consumption	Kw.-hr. per Hp.-Month
1	1 —1½	843	25,803	31
2	1¾—2	1,220	25,704	21
3	2½—3½	1,120	22,677	20
5	4 —6	8,753	230,683	26
7½	6½—8½	1,684	87,328	52
10	9 —12	2,512	140,376	56
15	12½—17	2,725	65,840	24
20	17½—22	2,196	64,614	29
25	22½—27	3,622	198,034	55
30	27½—32	1,934	52,006	27
35	32½—42	6,133	173,651	28
50	42½—62	6,218	246,015	40
75	62½—88	4,107	225,880	55
100	88½—112	5,043	166,970	33

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Limits to Alternator Voltage.—F. D. NEWBURY.—For fifteen years the maximum voltage for which generators have been wound has remained practically the same. To-day 13,200 volts is the highest standard generator voltage used in this country. There are several reasons why generator voltages have not increased. The first is that as the voltage passes 20,000 volts (requiring a test voltage of approximately 40,000 volts) the weight and cost of the generator increase rapidly and soon become greater than the combined cost of an equivalent lower voltage generator and transformer. Another reason is that the elimination of the transformer subjects the generator to the direct shock of all the abnormal voltage waves originating in the transmission system. Experience has shown the necessity of heavily insulating the turns of the transformer nearest the terminals—in fact, the first few turns are insulated from each other as effectively as the coils are insulated from ground. This protection is impossible in the generator unless each coil has only a single turn, but this would result in a prohibitive number of slots for the voltages under consideration even with the largest units and the highest speeds. The danger from abnormal voltages when the generator is directly connected to the transmission line is such that relatively few generators are so operated. The third reason is that circumstances have not favored the use of very high-voltage generators. Breakdown of 10,000-volt generators insulated with treated cloth has not been rare. The failures are due, first, to the chemical effect on cloth or paper of corona or static discharge that often accompanies the higher voltages, and, second, to the serious increase in dielectric loss that occurs in many cloth and paper insulations under the combined influence of high voltage and high temperature. The danger from corona is, roughly, a function of voltage alone; consequently high-voltage generators of all sizes are involved. The danger from dielectric loss is a function of both voltage and operating temperature; thus small generators with relatively low internal temperatures are immune while large turbo-generators in which the internal temperatures are usually in excess of 100 deg. are subject to this danger. With the higher generator voltages electrostatic stresses sufficiently high to break down air often occur, particularly at points and corners such as the edges of projecting laminations in the slots and the edges of the core ventilating ducts that are ground potential. The "static" or corona that results is accompanied by the formation of nitrous oxide and nitric-acid gases, which after a time disintegrate the vegetable insulation. On the other hand, mica is practically unaffected under conditions thus far encountered in practice and, so far as the author is aware, has never failed from this cause. Synchronous motors and generators are better adapted for the higher voltages than are induction motors.—*Sibley Journal of Engineering*, Cornell University, May, 1918.

Generation, Transmission and Distribution

Bibliography of Petroleum.—Countries and regions in which petroleum is found are pointed out, and transportation, storage and distribution, properties of oil and their determination, utilization and legal regulation regarding its use are discussed.—*Bulletin* 149, Department of Interior, Washington, D. C.

Regulating Combustion in Modern Furnaces.—L. CONGER.—A consideration of this subject as applied to equipment with artificial firing and mechanical grates. The author lays particular stress upon the importance of proper ventilation. To obtain the necessary variation in the speed of ventilating apparatus in central stations using three phase current there are three processes to choose from: (1) To transform the three-phase current into direct current and to operate the ventilators by direct-current shunt motors; (2) to transform the three-phase current into two-phase current by a Scott transformer and to connect each phase to a monophase variable-speed motor, thus permitting an equilibrium of the two circuits; (3) to install three-phase variable-speed motors with collectors. The author favors, as the most flexible and economical method, the use of direct-current motors.—*Revue Générale de l'Electricité*, May 25, 1918.

Feeding Monophase Electrometallurgic Ovens from Three-Phase Distribution Systems.—E. PIERNET.—The author examines the means of avoiding disturbances produced when the conditions in electrometallurgical plants necessitate feeding monophase ovens from three-phase networks.—*Revue Générale de l'Electricité*, May 18, 1918.

Traction

The Loetschberg Railway.—LUCIEN PAHIN.—A long article on this electrified railway in the Bernoise Alps, Switzerland, which constitutes an international route to the Simplon tunnel and will be an important factor in traffic between the north of France and both Belgium and Italy. The section between Spiez and Brigue, extending 73.8 km. (45.8 miles), is described in detail, including the power houses, distribution system and electric locomotives, the latter of 2000 hp. and 2500 hp. Interesting figures regarding the energy consumption are given.—*Revue Générale de l'Electricité*, May 11, 1918.

Installations, Systems and Appliances

Repulsion and Mutual Inductance of Reactance Coils with the Same Axis.—H. B. DWIGHT.—The article contains curves and gives examples of how the inductance of reactance coils can be found by the use of the curves. The curves also indicate the mechanical forces which may exist between reactance coils. These are compared with test values.—*Electric Journal*, May, 1918.

Industrial Controllers, Part XVII.—H. D. JAMES.—This article describes controller systems for mine hoists. Mine hoists are divided into two general classes, namely, those for coal mines and those for metal mines. The equipment is classified as contactor controllers, liquid controllers and voltage controllers. Besides describing and illustrating these three types of controllers, safety devices and brakes are also considered. The question of whether the advantages of automatic control of hoists, designed to stop the cars at either limit of travel and discharge their load, is adequate to make up for the complicated design and extra cost involved is also discussed.—*Electric Journal*, May, 1918.

Wires, Wiring and Conduits

Solution of Polyphase Network Problems by Using Symmetrical Co-ordinates.—C. L. FORTESCUE.—The author points out that unsymmetrical systems of co-planar vectors may be represented by symmetrical systems of the same number of vectors, the number of symmetrical systems required to define the given system being equal to its degrees of freedom. In the first part of the paper, which consists of three parts, the author deals with the resolution of unsymmetrical groups of numbers into symmetrical groups. These numbers may represent rotating vectors of systems of operators. A new operator, termed the sequence operator, is introduced, which simplifies the manipulation. Formulas are derived for three-phase circuits. Star-delta transformations for symmetrical co ordinates are given and expressions for power deduced. A short discussion of harmonics in three-phase systems is given. The second part of the paper deals with the practical application of this method to symmetrical rotating machines operating on unsymmetrical circuits. General formulas are derived, and such special cases as the single phase induction motor, the synchronous motor-generator and phase converters of various types are discussed.—Abstract of paper presented before A. I. E. E., June 28, 1918.

Electrophysics and Magnetism

Magnetization of Iron in the Absence of Hysteresis.—WINTHROP R. WRIGHT.—The magnetic characteristics of five steels, arranged in decreasing order of carbon content, were obtained at temperatures ranging from 20 deg. C. to the magnetic transformation point. The anhysteretic magnetization curve at a given temperature has three characteristics distinguishing it from the ordinary magnetization curves. The curve has no point of inflection, its slope at the origin is apparently infinite, and it does not intersect any other curve taken for a second temperature. Examination of empirical equations which have been proposed for anhysteretic magnetization showed that they represent the curve only very approximately.—*Michigan Technic*, May, 1918.

Electrochemistry and Batteries

Effect of Iron Sulphate in the Electrolytic Precipitation of Copper from Sulphate Solution with Insoluble Lead Anodes.—EDWARD F. KERN.—Solutions of copper sulphate containing varying quantities of iron sulphate were electrolyzed with insoluble lead anodes at different temperatures and with different current densities, in order to determine the effect of the iron salt present on the current efficiency of copper deposition at the cathode. The lowering of efficiency was found due to adduction of ferrous sulphate to ferric sulphate at the anode, and reduction of ferric sulphate to ferrous sulphate at the cathode. Results are given quantitatively.—Extracted from paper presented before the American Electrochemical Society, April 28, 1918.

Experiments with the Copper Cyanide Plating Bath.—FRANK C. MATHERS.—Current yields at the cathodes were generally lower than those at the anodes, which necessitated the making of regular additions of sodium cyanide to the baths. Sodium carbonate and perhaps sodium sulphate are valuable additions. A more concentrated solution than usually employed is recommended because the higher current can be applied and the thicker deposits obtained without bad edges or corners and the cathode yields are higher.—Extracted from paper presented before the American Electrochemical Society, April 28 May 5, 1918.

Telegraphy, Telephony and Signals

Signals from Central Stations to Customers.—PIERRE TRICHARD.—The author proposes a system of signals to users of electricity based on very slight periodic variations of voltage above and below normal. By using the phenomenon of resonance these signals could be received upon a voltmeter or upon a combination of two voltmeters. Transmission of the time and the multiple recording of energy consumed are two of the uses to which they could be put. In addition, as has actually been done, they would provide a means of giving the alarm in case of a threatened air raid.—*Revue Générale de l'Electricité*, May 18, 1918.

Miscellaneous

Copper and Aluminum in Germany.—Discussing the statements made recently by an official of the British Aluminium Company, a leading German newspaper observes that it is no secret that Germany has embarked upon the production of aluminum on a large scale during the war, although opinions differ as to whether the German works will be able to meet international competition after the war. It is considered certain, however, that the reported increase in the British production of aluminum, proceeding simultaneously with a very large augmentation in the output of copper in the period succeeding the war, will render not improbable some overproduction of the latter metal. If the copper needs of Britain and her allies are estimated at 50,000 tons per month for war purposes, the German newspaper remarks that it is obvious that these requirements will be considerably reduced the moment peace is concluded. This circumstance is regarded as of importance to Germany, as the newspaper states that it awakens the hope that the present exceptionally high prices for copper will fall through this disproportion between supply and demand, and especially that there will be no question that it will be rendered possible for Germany to continue to obtain supplies of the indispensable copper. —London *Electrical Review*, April 26, 1918.

Welding Cast Iron with the Electric Arc.—Economies are being effected in railroad repair shops owing to the successful repair of expensive damaged castings. The article describes the preparation of the material for welding, particular attention being given to the welding of locomotive cylinders, high-pressure cylinders and thin metal that is not subject to heavy stresses. —*Railway Electrical Engineer*, May, 1918.

Measurement of Dielectric Losses by Condenser Bridge

To the Editor of Electrical World:

Sir: In reading C. A. Butman's interesting article in your issue of March 9, describing the measurement of dielectric losses by the condenser bridge method, the writer's attention was drawn to several apparent errors. On page 502, in the paragraph headed "Formula for the Dielectric Constant," equation (6) is given as an expression for "the dielectric constant or specific inductive capacity." This is obviously an error. The dielectric constant is not a dimensional quantity; it is merely a ratio, as is evidenced by the qualifying adjective "specific." Equation (6) gives the capacitance of the author's condenser with air as the dielectric.

The discussion of the quantity cos θ_x sin θ_x of equation (12) is ambiguous because the author has apparently allowed r and c to vary simultaneously. In the paragraph on page 503 beginning "The experiments which follow show conclusively" it is stated that where $\theta_x = 90$ deg. there is an energy loss because the condenser has a perfect dielectric. Reference to Figs. 1 and 2 will show that θ_x becomes 90 deg. when the capacitance vanishes or the resistance r becomes infinitely large, constituting practically an open circuit, and the loss becomes zero on that account. On the other hand, θ_x becomes 0 when the condenser has a perfect dielectric with no energy loss.

In arriving at the conclusion on page 505 that "It was also found unnecessary to use a substitution method in measuring the capacity," it would appear that the author has eluded difficulties which have tried the souls of other experimenters when measuring capacitances as small as 0.0001 mfd.; but he has overlooked a splendid opportunity to secure the dielectric constant without being bothered with the calibration of his comparison air condenser. By taking a reading with his sample in place and then a second with the sample removed and his testing frame in air, the plates being set to give the same thickness of dielectric as in the first measurement, the dielectric constant is obtained directly as the ratio of the two readings of the variable resistance of the bridge. However, distributed capacitance is known to exist in resistance coils with the bifilar winding, and few inductors are free from this defect. Mr. Grover's article in the *Bulletin* of the Bureau of Standards points out that these residual capacitances enter directly into the value of dielectric loss obtained. Hence, if values of dielectric loss reliable to five significant figures are required, allowance for these reactances must be made or a substitution method employed. An equivalent of the substitution method could be easily secured by taking readings with the test apparatus used as an "air condenser" with two settings of thickness of dielectric. The best method is, of course, to use resistances of the Curtis coil type, which are very nearly anti-capacity.

Readers' Views and Comments

The author does not state the thickness of the metal plates used as electrodes nor does he make mention of the amount of pressure applied to the sample through the plates; hence it is impossible to estimate the degree of contact between the plates and the sample. It has been the experience of other experimenters that it is impossible to secure perfect contact between the sample and rigid electrodes even under great pressure, so that in testing these samples the measured dielectric constant is apt to be largely influenced by the dielectric constant of the medium in which the apparatus is placed. The Electrical Testing Laboratories use dish-shaped blocks of bakelite accurately aligned by dowels and clamped together with the sample between them. The space on either side of the dielectric is then filled with mercury, which constitutes the electrodes. A somewhat similar device is used at the Perth Amboy laboratory of the Standard Underground Cable Company. Incidentally, the writer knows that the latter company has been employing the bridge method for the measurement of dielectric losses for a number of years, and the results of such measurements by another investigator up to 6000 volts were published in the *Annalen der Physik* a good many years ago.

Gordon Thompson.

Electrical Testing Laboratories, New York.

To the Editor of Electrical World:

Sir: The following is a reply to the comments of Gordon Thompson relating to my article on the series inductance bridge.

1. The "formula for the dielectric constant," equation (6), is correct as given. The dielectric constant is the relation between the inductivity of a substance of certain dimensions compared to ether occupying the same space. Inasmuch as the dielectric constant of air is approximately unity, the specific inductive capacity is also given by the same formula.

2. It may make the expression cos θ_x in equation 12 more clear to state that the change in r and c is due to a change in the material between the condenser plates. As long as there is no change in the material, r and c will remain constant. When the bridge is balanced there is one and only one value of r and c. If now we consider the hypothetical condition as to what would happen if r did change and c remain constant and vice versa, we will arrive at the given conclusion.

3. It is important to note that the exact mechanism of electric conduction is not known, and that there probably is a difference between a perfect resistance through which no conduction current passes and a perfect dielectric which will transmit a displacement current. Further experiments are needed, such as tracing the change from a nearly perfect dielectric to that of a poor resistance by changing the temperature of a given substance.

4. Arranging the bridge symmetrically, reducing the capacity of the bridge to the ground to the lowest amount, grounding the bridge as shown in the diagram and placing the vibrator of the galvanometer directly in the circuit (the galvanometer itself being free from ground) showed that no auxiliary bridge like the one used by K. W. Wagner, or substitution method such as used by the United States Bureau of Standards, was necessary. The suggestion of having the galvanometer free from ground was due to Dr. P. Thomas of the Westinghouse research department.

5. Various ways of securing contact were tried, the most satisfactory being the testing frame developed. The brass plates of the frame were about ⅛ in. (3.1 mm.) thick and were backed with wood so as to be rigid. The end of the micrometer screw was so made as to allow the top brass plate to adjust itself to the nearly plane parallel test samples. The amount of pressure used was sufficient to secure good contact. The method of testing the amount of pressure was the amount of force used in tightening the micrometer screw. The value of the dielectric constant of glass obtained with the bridge and the testing frame was what was to be expected, as judged from results obtained by other experimenters using other methods. It might also be well to point out that, while contact over the whole surface is essential in resistance measurements, in electrostatic (i.e., inductive) measurements it is not so important. It is believed by the author that contact is at a sufficient number of points to provide a good electrical connection. It should not be lost sight of that the testing frame provides a means of testing the dielectric constant of liquids.

6. In case 10,000 volts applied potential is used it is necessary to place the samples in oil to avoid dielectric losses due to corona. As is pointed out, if some other substance besides that directly under test comes into the electrostatic field between the plates of the frame it is liable to influence the value of the dielectric constant.

7. A series *resistance* bridge was developed by Monash (*Annalen der Physik*, 1907) for measuring the dielectric loss angle, but not the following improvements. The Einthoven galvanometer may perhaps be replaced by a Leeds & Northrup alternating-current galvanometer. The Aryton-Perry type of variable inductance may be replaced with the less expensive Leeds & Northrup inductometer. The standard condenser can be replaced by a condenser made of plates immersed in micarta.

A slight improvement could be made by using the Curtis type of resistances as recommended by Mr. Thompson.

Chester Arthur Butman.

Rockport, Mass.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

CENTRAL-STATION ECONOMIES DISCUSSED AT SYRACUSE

Engineers and Operators in New York State Tell of Methods for Using Machinery and Material in the Most Efficient Way Possible

That economies can and must be effected in war time was the keynote of the meeting of the Electric Section of the Empire State Gas & Electric Association at Syracuse on June 21. Delegates who have charge of production and distribution departments in central stations of New York State talked about the labor situation, fuel conservation, 11,000-volt distribution and other important problems that need immediate solution in order to "carry on" the central station in the best way. The member companies were well represented, and every one took part, a roll call being taken as the subjects were discussed.

The consideration of how to use material usually scrapped, especially old duct cable, which can be utilized by splicing, brought out the statement that in Buffalo the later method had been practiced for fifteen years with great success.

It was pointed out how on the Syracuse system an 11,000-volt emergency line had been arranged so that it could be used for a 2300-volt tie line and switched back to its original use if necessary. By this method the energy from the water-power station could be better distributed and considerable generation by steam was eliminated. By utilizing a 250,000-circ. mil cable that happened to be in stock on a distribution system where B. & S. gage No. 0 was the size required feeder regulators and the necessity of buying cable of the correct size were eliminated in Rochester. At Syracuse one man is employed to repair transformer leads and bushings, and by this means the equipment is kept in first-class condition and it is not necessary to send transformers to outside shops except in rare cases.

Women in Industry

A discussion of the labor situation brought out the fact that many women were being employed by the member companies with satisfaction. In Buffalo seventy-three girls are being used in the office, where before the war only one woman was employed.

Testing, repairing and reading of meters is accomplished very efficiently in Binghamton. This work is greatly facilitated, however, by the fact that for several years the local company has required the meters to be placed in a central position on the consumer's premises and not much difficulty is encountered in reaching them. It was suggested that the central stations should study the possibility of employment of disabled soldiers in plants and in testing rooms in accordance with the request of the government.

In discussing fuel conservation one engineer told of a case in which the Fuel Administration had written to the owner of an isolated plant asking him to communicate with the central station to make an arrangement whereby the latter company could take over its load. The Fuel Administrator in Rochester has issued an order requiring that no gas or electric service shall be connected to the lines without his permission.

The effect of daylight saving was discussed by all the companies represented, and in some cases it was stated that plans were being made to induce factories to change working hours so that the peak of the commercial load could be shifted and would not coincide with the lighting load.

Obtaining right-of-way is the greatest trouble met with in serving customers from the rear lot, according to several engineers. In addition, when street lights have to be served from the same primaries considerable underground construction cannot be avoided.

Modern apparatus accounts for efficient operation of the steam station in Rochester, said one of the production engineers of that company. Bonus systems are used for increasing the operation in the engine room and boiler room in this plant.

Farmhouses along 11,000-volt lines can be served economically if the load of several consumers is sufficient to require at least a 5-kw. transformer. All that is required for protective means is fuses and choke coils on the transformer pole. In case lightning strikes the line the reactance of the transformer will choke the discharge back to the substation lightning arresters.

SCOPE AND APPLICATION OF NATIONAL SAFETY CODE

Circular No. 72 Issued by the Bureau of Standards Intended to Aid Those Interested in the Code

Circular No. 72 issued by the Bureau of Standards deals with the "Scope and Application of the National Electrical Safety Code." This circular is intended to aid those to whose attention the safety code has been called and those who are contemplating its adoption or use in acquiring the necessary familiarity with intent and scope. The need for the code is explained and examples of personal injuries by electricity are given, most of which will be found avoidable by observance of the rules.

The method of arrangement of the code to promote convenient use and the intended manner of application of the code by engineers and inspectors are briefly explained. A short summary is also given of the provisions of each of the four principal parts of the code. According to an announcement issued by the bureau, as the code is being adopted on trial by many administrative bodies and public utility companies, it is expected by the bureau that this circular will facilitate its introduction and aid in its interpretation.

Motor-Operated Bell Chime at Boston Store

Electrical advertising by a bell chime connected with a master clock is effectively utilized at the Filene Store, Boston, Mass., on the busiest street corner in New England. Four bells constitute the chime, which rings on the hours and half-hours according to the Westminster schedule. The chiming and striking are accomplished by an electrically controlled let-off tower clock mechanism installed in a corner of the store behind the bells. The mechanism is controlled by a regulator wall clock which also energizes the magnets in the movement of the bracket clocks. The magnet control current is supplied by Samson batteries.

WATER-POWER COMMITTEE AGREES ON A NEW BILL

Special Committee of the House of Representatives Decides to Recommend Legislation Similar to Administration Bill

The special committee appointed in the House of Representatives to consider all proposals for water-power legislation has completed its work and has agreed upon a bill which will be presented to Congress probably early in July. The bill is practically identical with what was known as the administration water-power bill, which was made the subject of hearings that have been reported in the ELECTRICAL WORLD.

In its essential features the bill provides for a federal power commission consisting of the Secretaries of War, Agriculture and the Interior. The President is to designate the chairman of the commission, which is to issue licenses for the development of water-power projects, the term of the license not to exceed fifty years. Licenses may be altered only upon mutual agreement between the licensee and the commission after notice of thirty days.

The licensee is to pay the United States "reasonable annual charges in an amount to be fixed by the commission." The original provision of a charge of not less than 10 cents per horsepower-year has been eliminated, and provision has been made for the readjustment of the charges at periods of not less than ten years in case the project includes dams owned by the United States. Licenses may be issued without charge for small projects of not more than 50-hp. capacity. In case licenses are issued to states or municipalities charges are not to be assessed on such power as may be used directly by the licensees.

Provision is made whereby the United States may recapture the project upon not less than two years' notice from the commission by paying to the licensee his net investment plus reasonable severance damages for property of the licensee not taken. The original definition of net investment is retained. The bill also contains the original options regarding the disposition of the project at the end of the fifty-year license period and relating to the regulation of rates of service and character of securities.

A new provision was written into the bill requiring the licensee to maintain out of surplus earnings, if any, accumulated in excess of a specified rate of return upon the net investment, amortization reserves to be held until the termination of the license or applied periodically in reduction of the net investment. The license may provide that any balance or surplus earnings shall be used in reduction of rates and annually returned to the consumer.

INCREASING FACILITIES TO MEET WAR-TIME DEMANDS

New England Power Company Expects to Expand Its Total Rating by 40,000 Kw. Before Next Winter, Partly by Interconnection

Forty thousand kilowatts of additional capacity will be available before next winter on the system of the New England Power Company to meet the demands of war industries, according to plans outlined by President Henry I. Harriman on June 20. This increase will in part be secured through interconnection with the lines of the Shore Line Electric Railway in Connecticut and with the system of the Edison Electric Illuminating Company of Boston at Dedham, Mass., supplemented by the addition of a 12,500-kva. steam turbo-generator and four boilers to the central station at Uxbridge, Mass., by the rewinding of the generating units in the No. 5 hydroelectric station of the power company near the Massachusetts-Vermont line on the Deerfield River, and by the addition of new boilers to the plant of the Narragansett Electric Lighting Company of Providence, R. I.

Mr. Harriman stated that at present the New England Power Company's entire output of hydroelectric energy is being sold. The increasing demands for power in industrial New England resulting from war activities render it absolutely necessary to procure 40,000 kw. in addition to present available capacity before winter. The high cost of equipment and construction renders it essential to combine resources as fully as possible, conserving both capital and fuel. The Shore Line Electric Railway of Norwich, Conn., which has a central-station business in that district, is building a new plant of 25,000-kva. rating on the Thames River, about halfway between New London and Norwich. This will supersede four or five small and inefficient steam plants now operating the road, some of which consume in excess of 4 lb. of coal per kilowatt-hour. These stations are interconnected by 33,000-volt lines. It is proposed to build a new line connecting the Shore Line

system with the New England Power Company's dispatching headquarters at Millbury, Mass., just outside Worcester, the New England company building that part of the line between Millbury and the Connecticut boundary, at an estimated cost of about $102,000.

This interconnection will enable the Power company to utilize the reserve capacity of the new Shore Line plant, which is equivalent to the rating of one 12,500-kva. unit, the initial installation providing for two turbines of equal capacity. This station is now under construction by the Harry M. Hope Engineering Company of Boston, piling and foundation work being in process. Mr. Harriman said that the total load of the Shore Line company is about 7500 kw., and that the construction of the new plant was hastened by the high cost of coal and by the necessity for supplying energy from the Shore Line plant to a boat-building establishment at New London. It has been agreed that if the Shore Line company will build a transmission line from its present system to the Massachusetts state line the New England company will purchase energy from the former for probably more than six months of every year, and the Power company will also supply the Shore Line load from midnight to morning, this totaling about 1000 kw. and being too small to permit of the economical operation of a 12,500-kva. unit.

ARRANGEMENT AT PROVIDENCE

Arrangements have been made with the Narragansett Electric Lighting Company, Providence, R. I., to install four additional boilers at the main generating station on tidewater at Providence, thus providing 10,000 kw. not previously available and enabling the full turbine capacity of this company to be utilized. The interconnection with the New England system through the Rhode Island Power Transmission Company, the affiliated organization's line, will enable energy to be interchanged as may be required. The Providence station is at present the largest steam plant connected by high-tension lines with and supplying energy to the New England system. It is now planned to tie the latter into the Boston Edison system by the construction of a 19-mile (30.5-km.) high-tension line from the Sudbury hydroelectric plant of the Metropolitan Water & Sewerage Board to the Dedham substation of the Edison company. This line is to be designed to transmit from 10,000 kw. to 15,000 kw. in off-peak energy. This interconnection will call for the laying of another cable between the Dedham substation and the L Street station of the Boston company, and it is expected that these interconnections will be permanent and useful after the war as well as at present.

Recently the New England Power Company was offered a 12,500-kva. steam turbine for immediate delivery, the manufacturers having received a cancellation order from another purchaser. The unit was at once accepted, and shipped for installation at Uxbridge, where the existing central station is interconnected with the hydroelectric system. Four 500-hp. boilers have been purchased, and to provide for this equipment the boiler house will be extended 60 ft. (18.2 m.) and the turbine room 30 ft. (9.1 m.). The turbine was purchased at a cost of about $201,000, and could not have been obtained for service this fall had it been ordered in the usual way.

At the No. 5 station of the Power company three double units are in service, delivering 25-cycle energy at one end for the Hoosac Tunnel electrification of the Boston & Maine Railroad and 60-cycle energy at the other for general use. These machines were installed about six years ago. Mr. Harriman stated that, like many units of earlier build, these generators were designed along very liberal lines with respect to material. Recent advances in insulation practice have made it possible to increase the output of many units by rewinding. The company needs additional peak capacity, and it has been ascertained that by installing new coils the capacity of the three units can be increased by a total of nearly 6000 kva., and at a cost of $3 per kilovolt-ampere for the coils alone. Other changes in the station bring the estimated cost of the enlargement to $83,765. A new 6000-kw. unit would cost around $20 per kilowatt at present prices, and at least $10 per kilowatt two or three years ago. If a new unit were to be installed it would be necessary to enlarge the station building and provide new gates and a new penstock. The present waterwheel is large enough in each case to drive the double generating set connected to it, even after rewinding the coils.

Mr. Harriman said that prices of electrical equipment are nearly double those of two years ago and that the labor cost in installation often equals the cost of the equipment itself to-day, or nearly so. Most of the construction work of the Power company, together with the engineering, is performed by the affiliated Power Construction Company, only a nominal profit being sought to cover actual costs. This arrangement is convenient in view of the doubtful authority of the Power company to act for other companies as an engineering or construction organization, especially on work outside the State. The New England Power system is being connected with the Fall River Electric Light Company by an 18-mile (28.9-km.) line, under construction for the Cabot interests of Boston by F. T. Ley & Company, and as this organization is working in the vicinity of Rhode Island, it is also being utilized in a short piece of line work in the latter State.

SUMMARY OF ESTIMATED (NOT ACTUAL CONSTRUCTION) COST OF ENLARGING FACILITIES OF NEW ENGLAND POWER COMPANY.

1. Uxbridge station, increasing capacity by 12,500 kva.	$768,500
2. Plant No. 5, increasing capacity from 12,600 kva. to 18,100 kva.	83,765
3. Pole line, single-circuit No. 1 copper, 15 miles, Millbury to Connecticut State line	102,300
4. Additional switching equipment, Millbury substation	4,200
Total	$958,765

When asked about the prospect of constructing the Davis Bridge Reservoir, in Vermont, Mr. Harriman said that at present it is out of the question to raise the necessary money by private capital, but that the additional storage is greatly needed, and, with the 112,000,000-kw.-hr. it would furnish annually, would be the salvation of the New England power situation. A bill has lately been drawn by Counsel Buckley of the Council of National Defense appropriating $200,000,000 for the use of the President of the United States on behalf of public utilities in such manner as he deems wise. It is hoped that New England will share in the benefits of this proposed act of Congress.

ELECTRIC POWER CONDITIONS IN THE DOMINION OF CANADA

Canadian Electrical Association Discusses Pressing Needs of Central Sections of the Country Now Enjoying Unprecedented Activity

The twenty-eighth annual meeting of the Canadian Electrical Association, which is affiliated with the National Electric Light Association, was held at the Chateau Laurier, Ottawa, on June 21. Considering the condition of electrical industry in Canada, the attendance was quite large, the central stations of the Dominion being seriously handicapped by labor shortage in the face of activity unprecedented in the history of the lighting companies. At the present time there is also a great shortage of power throughout the Province of Ontario, but the power conditions in the Province of Quebec are not quite so serious. It should be noted that from ocean to ocean the great centers of industry are supplied with electrical energy generated from water-power stations. In the eastern sections, notably in Hamilton and Montreal, large steam reserve stations are maintained, and inasmuch as nearly all the coal is obtained from the United States, the coal shortage of the Republic affects Canada as well. The tendency, therefore, is to load up the existing hydroelectric developments to the limit.

Condition of Canadian Utilities

The general conditions obtaining in the central-station industry throughout the eastern section of Canada were reflected in the address of D. H. McDougall of Toronto, the president of the association. Difficulties in obtaining coal and money are apparently as common in Canada as they are in the United States, and the necessity for higher rates is just as pressing. Speaking of the immediate problems, Mr. McDougall said:

"The war and its accompanying sacrifices and hardships have made it necessary that each one of us should assume additional burdens and responsibilities. Our industry has had imposed on it additional duties in the way of operating problems and overloads that required all the skill, nerve and ingenuity that we could muster, and our staffs have been depleted further by conscription and the other war drains, making the maintenance of service a very difficult matter.

"Few of us are able to finance any new extensions to our properties or maturing bond issues. This handicap has been largely met by charging customers the cost of line extensions and by intensifying loads on present lines. Station increases have been almost impossible to finance. In some quarters this has been offset by taking on off-peak business, and this has required the study of factory conditions to educate customers to the necessity and possibility of such methods of operation. The result has been that higher load factors are experienced and some plants have been operated at a load factor deemed impossible even two or three years ago.

"The next difficulty has been with our employees, whose numbers have been decimated by military service, to which they have willingly responded, and by conscription, which I believe has affected us so far in a minor degree.

"I think I am safe in saying that great disorganization on account of these wholesale changes in staffs has only been averted by the loyalty and unselfish performance of duty of those who for one reason or other were unable to answer the call of the bugle.

The Hydroelectric Power Commission

"The outstanding example of failure to live up to contract obligations in the service of electric power in Canada during the past year is the case of the Hydroelectric Commission of Ontario, which, with an unprecedented lack of foresight, made contracts for larger amounts of power than it was able to supply. The total amount of this shortage has been stated to be 100,000 hp., but, unlike the members of this association, the commission has so far been able to escape the consequences of this selling short of power, as it has refused to recognize the claims of its customers, based on the solemn contracts signed by it, and has pleaded that its shortage has been caused by the war.

"It is hard to believe that such immorality would be protected by the crown and that millions of dollars invested in plants depending on government contracts for their power should be shut down when many of them would otherwise be turning out munitions and other war necessities but for this breach of faith.

"This commission, in spite of its lack of business ability, is able to secure large sums for construction work, amounting to about $2,000,000 a year, because its undertaking is supported by the government, although the works it is building cannot be of any service to the country for years to come, long after the war will surely be over. In the meantime it is diverting this money so much needed for war purposes from the use of the people of Canada. The amount of money expended by the Hydroelectric Commission so far in transmission and distribution plants is about $70,000,000, and the estimated amount of taxes lost to the people, which they would collect from privately owned companies with similar properties, is about $1,500,000 per year."

Other speakers at the morning session were T. C. Martin, secretary of the National Electric Light Association, who spoke of the work of the national body for the year and of its war committees; Willis MacLachlan of Toronto, who spoke on accident prevention, and with the assistance of operators from the Ottawa Electric Company, gave a demonstration of resuscitation from electric shock; A. A. Dion of Ottawa, whose report for the overhead-line committee dealt chiefly with the grounding of high-tension and secondary circuits, and J. F. Nield of Toronto, who reported on electrical apparatus.

Four reports were made at the afternoon session, all of which were commented on. William Volkman of the Toronto Power Company reported on the changes made during the past year in the manufacture of meters. A part of the report was devoted to the determination of power factor, because with the load conditions and the extremely high cost of additions to line capacity any relief which might be obtained by improving the power factor of consumers' loads is of great importance. Three methods for determining the power factor of loads were outlined in detail.

H. E. Randall of Montreal reported on the commercial light and power sales and on the use of electricity during the past year. The great value of the central-station industry to the country and the important part

it is accomplishing in the production of munitions, in solving the servant problem, in the conservation of fuel, man power and material, and in building up industrial conditions of Canada, were described in detail.

As the Canadian Electrical Association's representative on the National Electric Light Association's lighting sales bureau, E. N. Hyde of Montreal reported on industrial lighting conditions.

A very interesting report was presented by P. T. Davies of Montreal on rate research. It was pointed out that the obligations of customers in Canada to provide themselves with suitable electrical apparatus have been increased in view of the shortage of power and the high cost of machinery. Nearly all companies are requiring customers to keep power factors within reasonable limits at all times and to pay for any deficiencies. An abstract of the report of this committee will be published in a later issue.

Officers for the coming year were elected as follows: President, A. Monro Grier, Canadian Niagara Power Company, Toronto, Ont.; first vice-president, E. A. Dunlop, Pembroke (Ont.) Electric Light Company; second vice-president, C. S. Bagg, Montreal Light, Heat & Power Company, Cons.; third vice-president, A. P. Doddridge, Quebec Railway, Light, Heat & Power Company; secretary-treasurer, W. Volkman, Toronto Electric Light Company. The managing committee comprises D. H. McDougall, Toronto Electric Light Company; J. S. Norris, Montreal Light, Heat & Power Company, Cons.; P. T. Davies, Southern Canada Power Company, Montreal; R. B. McDunnough, Quebec Railway, Light, Heat & Power Company; J. S. Gould, Citizens' Electric Light Company, Smith's Falls, Ont.; H. M. Hopper, St. John (N. B.) Railway Company; L. Pratt, Dominion Power & Transmission Company, Hamilton, Ont.; J. B. Woodyatt, Southern Canada Power Company, Montreal; W. H. McIntyre, Ottawa Electric Company; R. J. Beaumont, Shawinigan Water & Power Company, Montreal; H. E. Randall, Shawinigan Water & Power Company; A. V. Gale, Hull (Que.) Electric Company; J. F. Nield, Toronto Electric Light Company, and the president of the N. E. L. A.

The proceedings ended with a banquet in the Chateau Laurier at which seventy-five were present. Addresses were made by the incoming president, A. Monro Grier, D. H. McDougall and John Murphy, electrical engineer of the Dominion Railway Commission.

BANKERS WORKING ON PUBLIC UTILITY RELIEF

Committees in Large Cities Take Up the Question of Providing for the Necessary Financing Rquirements

In last week's issue of the ELECTRICAL WORLD the appointment of four New York bankers to consider public utility needs was reported. Committees are also being appointed in other cities with the idea that each local situation may be met directly in the community. In Philadelphia the committee is J. R. McAllister, John H. Mason, Effingham B. Morris, Arthur E. Newbold, Levi L. Rue, Joseph Wayne, Jr., and William P. Gest, chairman. The Chicago committee is George M. Reynolds, E. D. Hulbert and Frank O. Wetmore. A similar committee exists in Boston.

LABOR ARBITRATION IN GENERAL ELECTRIC PLANT

Company and Employees at Schenectady Works Agree to Submit Differences to Ex-President Taft and Frank P. Walsh

The Department of Labor announced at Washington on June 23 that the General Electric Company and 21,000 employees at the Schenectady works have agreed to submit differences to arbitration by ex-President William H. Taft and Frank P. Walsh, joint chairmen of the National War Labor Board. The company expressed a willingness, before arbitration was agreed upon, to increase wages 10 per cent; employees asked 25 per cent. The Department of Labor says:

Their agreement, signed by representatives of the company and of the men, binds both sides to abide by the decision of the arbitrators, whatever it may be. Intervention by the two chairmen of the board prevented a strike at the plant, it was brought out at the hearing. The men had voted to go out, but reconsidered the action when they were assured that the War Labor Board would assume jurisdiction.

Their demands are a 25 per cent increase in wages throughout the plant, which is 100 per cent organized; the application of the basic eight-hour day; modification of the physical test; equal pay for equal work, whether performed by men or by women, and an agreement by the company that such wage increase as may be granted shall be retroactive to May 1. The company demurred on the question of a retroactive increase, but agreed to it after the employees waived the point previously raised against the physical test.

Approximately 2800 women are employed in the plant. No complaints were made by the employees against the treatment they had received at the hands of the company. On the other hand, they praised the fairness of the officials, their willingness to meet with committees representing the workers at all times, as well as the cleanliness and general safety of the plant itself. They maintained their desire to serve the country by steady application to their tasks and offered only the arguments presented by many briefs and statistics that many of them are not receiving sufficient pay to make them able to meet the increased cost of living. It was brought out that all of the employees are owners of Liberty bonds.

WE HAVE just begun to appreciate the possibilities of social progress that lie in highly organized, genuinely co-operative industry and what is now called quantity production. The essential thing is to get everybody interested in the possibilities of increased production instead of in the paralyzing agitation which lays all emphasis upon the division of the product. If the commodities of trade which minister to the comfort and welfare of the people are produced in greater quantities and more economically than ever before, there is not the slightest doubt that there will be a broad distribution of them. Everybody who produces them will be striving to distribute them, and if the increase is in all kinds of products everybody will have something to give in exchange for the property or service of others.—*National City Bank, New York.*

MEETING OF THE N. E. L. A. SOUTHEASTERN SECTION

In the Atlanta Convention War-Time Questions Predominate—C. D. Flamigen, Athens, Ga. Elected President

The meeting of the Southeastern Section, National Electric Light Association, was held on June 19 and 20 at the Piedmont Hotel, Atlanta, Ga. Each day's session was opened by the singing of the "Star-Spangled Banner," and each talk had interwoven with it some reference to the world-wide war.

The first day's session was opened by a talk from Rabbi David Marx of Atlanta on "What the Public Expects of Public Utilities." He stated that the times are changing so rapidly that it is hard for an ordinary man to keep pace with the general changes and it must be without question exceptionally hard for the professional man to keep abreast with the times and still keep up with the changes in his profession. A compliment was paid to the men of the central stations who have not only carried on their work but have responded liberally with their own time and their companies' resources whenever the government has called upon them. Where a public corporation has a monopoly the public is entitled to a dividend, these dividends to be paid in service. The company is entitled to dividends to be paid in money. He further stated that the public does not object to pay a fair profit on service which it buys. The question which is raised between the public and the public utilities company is therefore not what is profit but what is a fair profit.

W. H. Glenn, Georgia Railway & Power Company, Atlanta, spoke on "Some of Our War-Time Difficulties." Mr. Glenn stated that the central-station, although a manufacturer, still could not be properly classed with the ordinary commercial manufacturer. The ordinary manufacturer, when the burden is thrown upon him to increase his output, may either lengthen the hours of his labor or may run two or more shifts, thereby increasing his output without a material increase in overhead. Moreover, should a burden of government work be thrown on an ordinary manufacturer, he can be relieved from supplying his other customers. These customers may object, but when the situation is explained they, as a rule, will not make serious opposition. With the central station it is practically impossible to state just when the load will come on; and when the ordinary business has imposed on top of it government work—that is, power and light to war industries, such as new munition plants, cantonments, etc.—the central station cannot reduce facilities voluntarily for serving other customers.

Mr. Glenn stated that from ten hydroelectric companies in the South there was sold approximately 1,500,000,000 kw.-hr. This is generated entirely from water power, which in turn saves a thousand trains, of seventy-five cars each, of coal. He further stated that he did not believe that public utilities at the present time were asking permission to raise their rates in order to make a profit, but that they were desirous simply to break even.

John W. Lieb, vice-president New York Edison Company and president of the National Electric Light Association, made a talk on "The N. E. L. A.—Its Work in Peace and War."

Mr. Lieb explained the workings of the different committees of the association and also the problems which they had been called upon to solve during the last twelve months. He also explained the formation of the National Committee on Gas and Electric Service.

L. K. Comstock, New York, spoke on "A Proposed System of Wage Adjustment." Mr. Comstock showed by a series of tables that it was possible to base wages on a certain definite sum and that wages could be adjusted from time to time in order to take care of the rise and fall in the cost of living.

The session of June 20 was opened by E. H. Sniffin, who spoke on "Co-operation Between Manufacturer and Utility." Mr. Sniffin stated that the output of central stations increased about 100 per cent every five years and that the expenditures increased in about the same ratio. He said that during the same period the average man had almost doubled his consumption of electrical energy, but it had cost him only 20 per cent more than the original amount. He said also that in 1902 there was for every $100 of capitalization about $75 invested. In 1912 for every $100 capitalization there was $100 invested. In 1917 for every $100 capitalization there was approximately $125 invested. He stated that he believed the solution of the manufacturers' cost problems lay in the straightening out of their annual sales curve. He also recommended that a system of progress payments be inaugurated similar to that used by the builders' trade.

The report of the committee on public policy was read by the chairman, John S. Bleecker, vice-president Columbus (Ga.) Power Company. After the reading of this report there was a general discussion regarding rates and policies of the different companies.

Report of Public Policy Committee

The committee reviewed the development of public policy, suggesting that its real function is to discover the policy of the public and that it should be called "the public's policy committee." To-day, the report added, the industry is recognized, as it surely must have become recognized sooner or later with or without the war, as a national necessity.

After referring to the support given to the utilities by President Wilson, Secretary of the Treasury McAdoo and Comptroller of the Currency Williams, the committee said:

> Our real American public wants nothing so much as "fair play," and, if we recognize the fact that we are not free agents to do as we please with our properties but that we must follow the public's policy, we shall be upheld and supported by enlightened regulating authorities and made to be in fact as well as in name a vital, necessary cog in the national wheel, which, slowly but surely, firmly but fearlessly, patiently but persistently, is grinding a path toward world liberty and perpetual peace.

The following officers were elected to serve during the ensuing year: President, C. D. Flamigen, Athens, Ga.; first vice-president, George W. Wygantt, Tampa, Fla.; second vice-president, S. B. Ireland, Montgomery, Ala.; executive committee, W. R. Collier of Atlanta, L. L. Newman of Birmingham, D. H. Cheney of Orlando, Fla., H. H. Carr of Raleigh, N. C., and C. M. Benedict of Charleston, S. C.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Employee in Interstate Service.—An employee injured while working on a main power line carrying alternating current to substations, which converted it to direct current for operating cars in interstate commerce, was not injured in interstate commerce, his employment being too remote, the Supreme Court of California held (171 P. 1071).

Change of Rates by Receiver.—The courts of the State have no jurisdiction to appoint receivers for the purpose of regulating the rates of public service corporations, and neither the courts nor the receivers of such corporations have jurisdiction to change legal rates without the consent of the Public Utilities Commission, but when the legal rates charged by the receiver of a public service corporation have been enjoined by a court of competent jurisdiction the receiver may put into effect rates to be charged until the commission establishes a new rate, the Supreme Court of Kansas held (172 P. 713).

Negligence of Fellow Employee.—One dealing with and transmitting a dangerous and deadly electric current, whenever reasonably chargeable with knowledge, or when the facts are such as to make it reasonably probable, that persons may lawfully come near its wires and be exposed to danger therefrom, must take every precaution accessible to obviate the danger of injury and must use the utmost care to keep and maintain the wires so as to prevent injury, the Kansas City Court of Appeals held in Ratliff versus Mexico Power Company (203 S. W. 232). In an action by the widow of an employee in a city laundry who, while in the city's power house under permission of its superintendent, was killed when a laundry pipe held by another laundry employee who was attempting to open the door of the power house came into contact with defendant's wires transmitting power to the power house and, establishing a contact, caused a fatal injury while deceased was lifting the latch to open the door, it was held on the evidence that defendant was negligent in not insulating its wires so as to prevent such contact. In such case the deceased was not a trespasser at the time he was killed; the negligence of deceased's fellow-servant in establishing a contact with defendant's transmission wire could not be imputed to the deceased, and furthermore the negligence of deceased's fellow-servant would not absolve defendant if its negligence concurred with that of the fellow-servant in causing death.

Reasonableness of Rate Order.—Evidence in the record examined in connection with the objections urged as to the values fixed by the commission being held to support reasonably the findings of fact as to values, and the presumption being that such order is reasonable, just and correct, the order must be affirmed, the Supreme Court of Oklahoma held in Comanche Light & Power Company versus Turner (172 P. 792).

Interference with Telephone Lines.—Under the laws authorizing the construction and maintenance along highways of electric transmission lines, but expressly providing that such a line shall not interfere with the service of telephone or telegraph lines already constructed on such highways, whether such a transmission line is properly or improperly constructed and operated is immaterial where interference with existing telephone or telegraph lines is shown, the Supreme Court of South Dakota held in Tri-County Mutual Telephone Company versus Bridgewater Electric Power Company (167 N. W. 501). The law adopts the rule that priority of time carries with it priority of right. Injunction is a proper remedy for a telephone line against a subsequently erected electric transmission line to enforce the protection against interference with operation given by express provision of Laws of 1913, Chap. 369, the telephone company not being restricted under the statutes to an action for damages from such interference.

Injuries from Dam Construction.—The Laws of 1907 provide that in case it shall be necessary to take, flow or injure any lands or property for the purpose of the construction or use of a dam the licensees shall be subject to the provisions and entitled to all benefits and remedies of the Statutes of 1898, paragraphs 3374-3406. Section 3 provides that for acquiring the necessary lands or rights, easements or privileges in lands necessary for the complete and successful construction of the dam and improvement of navigation the said licensees may enjoy the rights granted to corporations by the Statutes of 1898, paragraphs 1777-1777e. Paragraph 1777e provides that such corporations may acquire title to necessary lands or easements by purchase or lease or by eminent domain, and in case it shall be necessary to take, flow or injure lands and property, such lands and property or easements therein may be acquired in the manner prescribed by the statutes with reference to condemnation by railroads. The Supreme Court of Wisconsin (167 N. W. 445) held that a power company is liable for injury to lands made permanently unfit for agricultural purposes by the backing up of water by its dam, as well as for lands actually overflowed, the word "injure" being used in its popular sense, namely, an act resulting in damage. In authorizing power companies to erect dams the state may impose such terms as it chooses and the licensees must conform to them.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

A. I. E. E., Fort Wayne Section.—P. C. Morganthaler was elected chairman and O. B. Rinehart was elected secretary of the Fort Wayne (Ind.) Section of the American Institute of Electrical Engineers on May 31.

Jovian Electric League, Los Angeles.—John S. McGroarty gave an address at the June 12 meeting of the league on "The Patriots of Power." C. H. Pierson, advertising agent of the Southern California Edison Company, acted as chairman of the day.

A. I. E. E., Philadelphia Section.—J. H. Anderton presented an illustrated address on "The Big Creek Development of the Southern California Edison Company" before the Philadelphia Section of the American Institute of Electrical Engineers recently.

American Drop Forge Association.—At the fifth annual meeting of the American Drop Forge Association at Buffalo on June 21 Arthur D. Farr, sales manager of the Hess Steel Corporation, Baltimore, Md., presented a paper on "Electric Steel Making."

A. I. E. E., Washington Section.—For the coming year J. E. Smith has been elected chairman and Milton Flanders secretary of the Washington Section of the American Institute of Electrical Engineers. Motion pictures on "The War and the Electrical Industry" were shown at the last meeting.

Tri-State Water and Light Association.—The eighth annual convention of the Tri-State Water and Light Association of the Carolinas and Georgia was opened on June 13. Among the speakers at this three-day session were Thomas Fuller, T. W. Moore and C. H. Cabinett of Atlanta and J. E. Guilford of Macon.

Mississippi Electric Association.—H. F. Wheeler, general manager of the Hattiesburg Traction Company, was elected president, and L. O. Gordon, general manager of the Jackson Light & Traction Company, was elected secretary and treasurer of the Mississippi Electric Association at the annual meeting, held at Hattiesburg May 23 and 24.

Recommendation of I. E. S. Committee on Nomenclature and Standards.—A meeting of the committee on nomenclature and standards of the Illuminating Engineering Society was held recently in New York. As a standard value for the mechanical equivalent of light the figure 0.0015 watt per lumen is recommended. A sub-committee was appointed to prepare a recommendation regarding the proper crossing point of spectrophotometric curves.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Plot Rumored at Cleveland.—Timely discovery of two dry boilers at the municipal light plant at Cleveland, Ohio, on June 11 prevented an explosion. The other three boilers in the battery were flooded. A water tender, in the employ of the plant only a short time, disappeared. Detectives working on the matter hint in their reports at a German plot.

Cleveland Municipal Power Rates to Be Increased.—Light Commissioner W. E. Davis has announced that, effective July 1, the power rates charged by the municipal light plant of Cleveland, Ohio, will be increased. The increase will cover merely the increase in cost of production, he said, and no attempt will be made to secure a profit. Long-time contracts have stood in the way of such a step heretofore.

Lexington Franchise Amended to Increase Rates.—The Board of City Commissioners of Lexington, Ky., at a recent meeting approved a "rider" to the franchise of the Lexington Utilities Company permitting an increase of 20 per cent in commercial and power rates to all consumers. The company officials state that the charge is a war measure and is necessitated by increased cost of production.

Furnace Makers to Aid in Conservation.—Representatives of the stove and furnace manufacturers have been conferring with the conservation division of the War Industries Board regarding a program that is necessary to meet war conditions and promote the saving of iron and steel, fuel, transportation and labor. The furnace manufacturers have already suggested action which would mean a reduction of 75 per cent of the styles and sizes of furnaces now on the market.

Controversy at Paris, Ky., Gets Into Court.—Because the city had not paid its light bills for three months, the Paris (Ky.) Electric Light & Gas Company discontinued connections with the city rock quarry, city hall and fire department on June 11. A temporary restraining order was issued by the Bourbon Circuit Court. The company is operating without a contract, and the city claimed that its rates were unreasonable. This was given as a reason for withholding payment of the bill.

Cleveland Rate Case.—On June 20 the Ohio Supreme Court ruled that $1,112,070 shall be deducted from the valuation of the Cleveland Electric Illuminating Company property, as fixed by the Public Utilities Commission. This means that the service rate will be based upon a valuation of $18,549,172, instead of $19,661,242, the latter being the figure fixed by the commission. The deduction was made from the amount allowed by the commission for attaching business. All other portions of the valuation were sustained.

Rate Advances at Byllesby Properties.—Since Sept. 1, 1917, increased rates for utility service have become effective at 297 communities served by the following properties managed by H. M. Byllesby & Company: Fort Smith Light & Traction Company, Mobile Electric Company, Northern States Power Company, Oklahoma Gas & Electric Company, Ottumwa Railway & Light Company, Puget Sound Gas Company, San Diego Consolidated Gas & Electric Company, Tacoma Gas Company and Western States Gas & Electric Company.

Optical Glass Supplied Here.—At present, as a result of co-operation between the manufacturers and scientists, large quantities of optical glass of the kinds needed for military fire-control instruments are being produced of a quality equal in practically every respect to the best European glass. The need for a continuous and assured supply of optical glass is so great that the workmen trained in the details of manufacture and subject to draft are being withheld in order that their technical training may be utilized at this time. The required information and details of manufacture and the skill necessary for proper production have been gained at great expense and under high pressure.

Bankers Told of Utility Needs.—Charles G. Dawes of Chicago, speaking at Sycamore, Ill., before the twelfth annual meeting of Group 3 of the Illinois Bankers' Association, declared that the future financial solvency of the public utilities of the country depends upon increased rates for their products and their services. The utilities, Mr. Dawes declared, are paying war-time prices for materials, labor and betterments, with incomes based upon peace prices. "What this means in relation to the general financial conditions in the United States," he said, "may be inferred from the fact that there is outstanding upon public utilities in the United States a bonded indebtedness amounting to $5,143,000,000."

Manufacturers' War Service Bulletin.—The General War Service Committee of the Electrical Manufacturing Industry has sent to every electrical manufacturer a copy of War Bulletin No. 35 of the Chamber of Commerce of the United States which, it says, "constitutes an official definition of less essential industry and describes how the War Industries Board will restrain all less essential industry in promoting industry essential to winning the war." Attention is particularly directed to the comment of the war service committee of the Chamber of Commerce of the United States, inviting suggestions regarding operations under the policies of the War Industries Board to the end that the board may be assisted in the administration of its policies to the desired end.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Higher Rates to Promote Development.—The California Railroad Commission has authorized the San Joaquin Light & Power Corporation to increase all electric rates by imposing a temporary surcharge of 10 per cent on all bills. The commission provides that the surcharge shall remain effective only until the end of 1918, or until the company's increased operating expenses have been met. The decision states that the amount paid by the company for fuel alone will increase from $60,000 in 1917 to $325,000 in 1918. The increase is due both to a shortage of snow and rainfall on the watersheds from which the company secures the water for its hydroelectric energy and to the increased cost of fuel oil. The company is directed to send out bills as formerly and to add an additional 10 per cent to meet the present increased cost of operation. The decision also establishes rules and regulations for extensions to be made by the company.

Increase Allowed in Colorado.—In allowing an increase in electric rates by the Colorado Springs Light, Heat & Power Company the Colorado Public Utilities Commission expresses the opinion that "such increases as are necessary at this time should be borne uniformly by the majority of the consumers of the company. Increases made in a prior order in this case were confined entirely to the large power consumers. While an increase in the rates to the small consumers will be made, the commission desires to call attention to the fact that even under the present war conditions such increased rates are lower than those paid by such consumers prior to the first order affecting the rates of this company. In the opinion of the commission no change should be made in the present rates for street lighting, sign and display lighting or electric heating." The fuel clause covering large light and power service follows: "The energy charges herein provided are based on coal costing not less than $2 nor more than $2.50 per ton delivered at the main steam plant of the company. When such coal cost is in excess of $2.50 per ton as shown by the records of the company for the previous calendar month, the above base rates shall be increased 0.15 mill per kilowatt-hour for each increase of 10 cents per ton, and when such coal cost is less than $2 per ton, the above base rates shall be decreased 0.15 mill per kilowatt-hour for each 10 cents per ton decrease in the cost of coal, provided that this fuel clause shall not apply to the first 20,000 kw.-hr. of monthly consumption."

J. Hadley Hatch of the Public Service Company of Northern Illinois has been commissioned an ensign and sent to Annapolis for four months' training. Mr. Hatch is twenty-two years old. He obtained his engineering education at Northwestern University.

Charles B. Hill, vice-president and general manager of the Cooper Hewitt Electric Company, Hoboken, N. J., who has been seriously ill for the last three months and was at one time believed to be in a very dangerous condition, has practically recovered and after a rest and vacation will be able to take charge of the company's affairs again.

A. B. Cole has been appointed assistant to the manager of the department of publicity, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., to succeed M. C. Turpin, who has accepted a position in the Ordnance Department at Washington. Upon graduation in 1909 from the School of Electrical Engineering, Purdue University, where he made a specialty of steam and electric railway studies, Mr. Cole entered the engineering apprenticeship course of the Westinghouse company. He completed this work in 1911. While on the course he was engaged, in addition to the regular shop testing, on railway project work in the general engineering division and as a railway sales correspondent at East Pittsburgh and afterward in the Cincinnati district office. Recently Mr. Cole has been co-operating on publicity matters with the American Electric Railway Association war board at Washington, spending half of his time in Washington and the remainder in East Pittsburgh.

Dr. Charles W. Burrows, associate physicist of the National Bureau of Standards in charge of the magnetic section of that institution, has resigned and will take up the work of commercial research and consultation, with laboratories equipped for research on problems involving magnetic materials and apparatus, at Grasmere, borough of Richmond, New York City. In 1905 Dr. Burrows received the degree of doctor of philosophy from the University of Michigan. Since then he has been a member of the scientific staff of the National Bureau of Standards at Washington, D. C. During this period he has reduced practical magnetic testing to an exact science. The Burrows magnetic permeameter is an extensively used method for commercial as well as for precise magnetic measurements. His greatest achievement has been in the discovery and development of the science of magnetic analysis. Dr. Burrows is a fellow of the American Institute of Electrical Engineers and a member of the following committees: National Research Council, aeronautical instruments, submarine mines; National Safety Council, safety devices of the mining section; Railway Signal Association, direct-current relays; American Society for Testing Materials, magnetic testing (chairman), electrical standards, methods of testing, standing committees.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

C. A. Hall has been appointed manager of the electric light and power department of the Eastern Pennsylvania Railways Company, Pottsville, Pa., which property is operated by the J. G. White Management Corporation, New York, N. Y. After leaving school in 1904, Mr. Hall entered the employ of the Consolidated Light Company, Huntington, W. Va. In 1907 he joined the organization of the Ohio Valley Electric Railway Company at Huntington. He became superintendent of the Canonsburg (Pa.) Electric Light, Heat & Power Company in 1909, and following the purchase of this utility in 1911 by the West Penn Power Company of Pittsburgh, Pa., he was appointed local manager of that corporation in charge of the Canonsburg territory. Under Mr. Hall's management this property was entirely rebuilt and many improvements to the service were made.

Obituary

John Bottomley, vice-president and director of the Marconi Wireless Telegraph Company, died on June 16 in New York City, after a brief illness, at the age of seventy years. He was born in Ireland in 1848 and received his education at Queens College. In 1880 he came to America, took up the study of law and was admitted to the bar. In 1898 he first met Mr. Marconi and took up the task of introducing wireless telegraphy into American commerce. In 1902 he became general manager, secretary and treasurer of the Marconi Wireless Telegraph Company of America and later became vice-president. He was a past-president of the New York Electrical Society. Mr. Bottomley was a nephew of the late Lord Kelvin and a grandson of James Thomson, the scientist.

Dr. Eugene Wilson Caldwell, X-ray expert and inventor of many devices in the development of the use of this invention, died on June 20 as a result of injuries received many years ago while experimenting with the X-ray. He engaged in experimental work in telephony to lightships in 1894 and 1895 and for the next two years was assistant in the engineering department of the New York Telephone Company. In 1905 he obtained his medical degree. He became interested in the physical problem of the X-ray and was the first director of the Edward N. Gibbs Memorial X-Ray Hospital. Dr. Caldwell was the inventor of the Caldwell liquid interrupter of special forms of X-ray tubes and of many appliances for use with Roentgen rays.

C. O. Baker, president of the firm of Baker & Company, Inc., gold, silver and platinum refiners, died suddenly on June 13 in his sixty-first year. He was one of the pioneer platinum refiners in the United States and early in life had an important part in the promotion of electricity for general uses. For several years he was president of the Electrical Exhibition Company and was connected with many progressive enterprises in the electrical field. He was also for a number of years master of transportation for the National Electric Light Association.

Howard L. Coburn, for fourteen years chief engineer of the Ambursen Construction Company of New York and Boston and designer of some of the largest hydroelectric plants in the United States and Canada, died on June 21, after a short illness, of pneumonia. He was graduated from the Massachusetts Institute of Technology in 1887. Later, as a member of the firm of Lockwood, Greene & Company, he designed many of the largest cotton mills and power plants in the Southern States and New England. In 1904 he became chief engineer and director of the Ambursen Construction Company and in this capacity designed and constructed the Guayabal dam for the United States Irrigation Service in Porto Rico and the Bassano dam across the Bow River in Alberta, Canada. He also built the Shoshone and the Laprelle dams in Wyoming. In addition to this work he was associated as consulting engineer with Henry L. Doherty & Company, E. W. Clark & Company and H. M. Byllesby & Company.

P. T. Glidden, for several years manager of the Northern States Power Company, St. Paul division, died on June 18 after a lingering illness. Mr. Glidden was born in Massachusetts in 1870. At the age of nineteen he entered the employ of the Holtzer-Cabot Electric Company, leaving in 1893 to go with the Schaeffer Electrical Company. Two years later he joined the staff of the New York Edison Company and for eight years he was in the operating, business and commercial departments of the company. He spent 1903 with the Ohio Brass Company, and in 1904 he became manager of the new-business department of the Binghamton (N. Y.) Light, Heat & Power Company. After a year and a half he was elected vice-president and general manager and a few months later took charge of the Sayre (Pa.) Electric Company. A year later he became vice-president and general manager of the Easton (Pa.) Power Company, retaining management of the Binghamton and Sayre properties until he became associated with the Louisville Lighting Company. In 1913 he left Louisville to go to St. Paul as manager of the Consumers' Power Company. When this company a short time ago became the St. Paul division of the Northern States Power Company he retained the St. Paul managership. Mr. Glidden was president of the Minnesota Electrical Association during 1913-14.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

DISCOUNTS SHOULD DEPEND ON QUANTITY AND SERVICE

Economical Units of Manufacture, Cost for Distribution to Jobber and Then to Retailer the Three Factors That Govern Price

The subject of trade discounts formed an interesting part of the address of J. Nelson Shreve, president of the Electric Cable Company, before the State convention of the New York Electrical Contractors' Association at Saratoga Springs this week.

In establishing prices, Mr. Shreve pointed out, the manufacturer must consider:

1. The most economical units in which he can manufacture.
2. A fair additional cost for distributing them in quantities used by the wholesale trade.
3. The further additional cost for distribution in quantities suitable for the retail trade.

Discount, it was stated, is the recognition by the manufacturer of the service function fulfilled by the jobber and the contractor. There are only two reasons for a discount, quantity purchase and service.

"A concern that claims maximum discounts," said Mr. Shreve, "from a manufacturer on any basis but that of quantity and service should not have the claim recognized. The fact that a concern is in the electrical jobbing or the contracting business, or a member of an association, is not sufficient reason for according the recognition asked for. To do so would be unjust to those whose services entitle them to the maximum consideration. Manufacturers' selling schedules should be arranged on a basis of differentials which attract and encourage the wholesaler to buy in the most economical units, and the retailer, in turn, to buy so as to render maximum service to the manufacturer, the jobber and the consumer."

EFFECT OF STEEL ORDER ON STOCK ACCUMULATION

Necessity of Shoving Orders of War Nature Ahead Affords No Opportunity for Replacing Goods Shipped from Stock

Now that it is impossible to obtain steel except where the goods are to be used for war work of some nature, a number of problems are arising that require a quick answer. According to a strict interpretation of the ruling, a manufacturer must show a bona fide war order before he can obtain a priority for steel shipment. Priority orders, however, constitute 100 per cent of steel production. Steel will not be shipped, therefore, for the manufacture of stock parts.

To carry this one step further, a manufacturer buying from a fabricator of parts cannot buy parts except for war work. If [illegible] be the condition, the manufacture for stock of goods in [illegible]ing steel is forbidden automatically. Such a condition would, of course, defeat the purposes of the government in many instances. In these cases business men have suggested that a remedy will soon be found and applied. Generally speaking, however, factories are filled up ahead of capacity and consequently will be able to place orders for steel coincidently with receipt of order for finished products. In these cases no delay should result.

With the jobbers, however, the situation takes on a different complexion. Since the fall of 1915 the jobbing business has become more than ever before one of immediate delivery from jobber's storehouse. In order to render this service, stock naturally must be kept on hand. When the government wants some of this stock it gets it quickly, but there are no priority orders forthcoming for replenishing the stock.

In other words, the jobber by the very nature of his business is precluded from laying up a stock of steel goods after the stock held by manufacturers has been depleted. When that occurs the jobber will probably occupy the same position that he now holds with respect to conduit, the manufacturer shipping directly to the government user on jobber order.

COTTON COSTS REFLECTED IN ELECTRICAL GOODS

Advances of 100 to 350 per Cent in Cotton Goods and Yarns Account for Much of the Higher Cost of Insulated Wire, Tapes, Etc.

Rising prices of raw materials inevitably affect the cost of manufacturing electrical products of many kinds, though it is difficult to predict just what the influence of a given advance in raw-material cost will be upon the selling price of equipment in any particular case. There are two principal reasons for this—the latitude allowed the cost department or price-fixing branch of the manufacturing organization in compensating for the advance and the varying amounts of any particular material used in different types, forms or sizes of apparatus. Nevertheless, it is possible to instance actual figures drawn from practice to show that changes in raw or finished component material costs may have an appreciable effect upon the ultimate price of the finished product.

An investigation along this line was recently made by the ELECTRICAL WORLD with respect to the effect of price changes in cotton upon the selling price of electrical equipment. Cotton has undergone an extraordinary change in price since the beginning of the war. Spot cotton was quoted at 12.50 cents per pound in New York City on July 30, 1914, the day the Cotton Exchange closed, and on Nov. 16 of that year the price upon the reopening of the exchange had fallen to 7.75 cents. During the interim President Wilson inaugurated the "Buy a bale of cotton" movement, and at that time the price was about 10 cents. It is well known that since the fall of 1914 cotton has increased in price until it passed the 30-cent mark in the spring of this year, shot up to 36 cents or thereabout on a speculative drive, and the quotation of June 22 was 30.4 cents. Electrical insulation is dependent upon cotton as its base material, and of tapes alone probably 97 to 98 per cent are fabricated of cotton yarns. Wire covering and many other products are affected by the rising and falling prices of cotton, but it appears that the day-to-day temporary fluctuations have less influence upon the resulting cost of electrical equipment and supplies than the longer and more sweeping changes. The reason for this is doubtless that manufacturers are accustomed to purchasing raw material of a cotton base far ahead of the dates upon which this material is to be utilized in production, and the market price at some future time may be taken into account rather than the price actually paid some months previously for a given consignment of insulating material base, when the establishing of sales figures takes place.

The accompanying table gives an idea of the changes in price of gray goods, muslin, tape, varnished cloth and yarn since the war began, these increases ranging from 106 to 342 per cent. These materials all bear the marks of increased labor cost as well as of increased raw-cotton price,

and in the case of tape alone it is known that labor cost has increased certainly 50 per cent since the outbreak of the war.

On account of the increase in the price of material manufactured from cotton, the total cost of generators and motors, which are insulated with cotton tape, has been increased from 0.5 per cent to 1.5 per cent.

In the case of the coarser sizes of wire the range in price from the beginning of the war was from about 14 cents per pound to 39 cents, this being due in part of course to the increase in the price of copper and also to higher labor charges. An analysis by the cost department of a prominent wire maker indicates that of this increase probably about 7 cents per pound can properly be charged to the rise in the price of cotton from 12.5 cents to 30 cents. Magnet wire rose from 18 cents to 33 cents per pound between 1914 and 1918, and about 9 cents of this may be attributed to cotton price advance, the smaller wire having a relatively larger amount of cotton insulation.

The buyer of electrical machinery and supplies using cotton must therefore realize that raw material advances are properly a part of the increased cost of the products which he uses, and that the influence of such advances depends in large measure upon the amount of material involved in his purchase in relation to the increase in the cost of labor. The table follows:

	Before the War Prices	Last Paid Price	Approximate per Cent Advance Last Paid Over Before War
68/72 gray goods.....	$0.06 yd.	$0.21 yd.	250
4/4 muslin	0.08 yd.	0.255 yd.	219
Cotton tape	0.385 gr. yd.	1.05 gr. yd.	173
Varnished cloth	0.108 yd.	0.307 yd.	184
Cotton yarn—coarse ..	0.215 lb.	0.95 lb.	342
Cotton yarn—fine	0.85 lb.	1.75 lb.	106

METAL MARKET SITUATION

Increased Production of Copper Assured—Imports Restricted—Price to Remain Unchanged

After the discussion about an increase in the official price of copper, it is now said there will be no change at the expiration of the time limit. The chief matter of interest taken up at the meeting last week in New York City of the producers and sales managers of the distributers of copper was that of shipments. The increased productive capacity of the mines was also brought forward, and it now appears there will be sufficient metal for all war work as well as for civilian users.

The War Trade Board has revoked all outstanding licenses for the importation of copper ore from overseas, except from Cuba, excepting for shipments made prior to June 10. No new licenses for shipments made from overseas after that date will be issued. The purpose of this regulation is to bring about the importation of copper matte (copper concentrates), instead of the bulkier crude ore.

Very slight changes have occurred in other metals.

NEW YORK METAL MARKET PRICES

	June 17	June 24
Copper:	£ s d	£ s d
London, standard spot....	110 0 0	110 0 0
	Cents per Pound	Cents per Pound
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	26.25	26.25
Lead, trust price	7.82½	7.82½
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter....	Govt. price 15.00	Govt. price 15.00
Spelter, spot	8.07½	8.57½
Tin, Chinese*	90	90
Aluminum, 98 to 99 per cent.	Govt. price †33.00	Govt. price †33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire.....	21.50 to 22.00	21.50 to 22.00
Brass, heavy	13.50 to 13 75	13.50 to 13.75
Brass, light	10 50 to 11.00	10.50 to 11.00
Lead, heavy	6.00 to 6.50	7 00 to 7.25
Zinc, old scrap	6.00 to 6.12½	6.25 to 6.50

*No Straits offering. †In 50-ton lots or more; carload, 33.10 cents per lb.; 1-ton to 14-ton lots, 33.20 cents per lb.

THE WEEK
IN TRADE

ADVANCES in the price of staples and other electrical merchandise, which started on the Atlantic seaboard, have reached the central sections of the country, the Pacific and Northwest States. Some further increases in New England are also reported, with still others on certain lines predicted. Sales continue to mount in size and further activity seems certain. The purchase of electrical equipment in the Pacific Northwest is running along high levels for new construction work in the shipyards and other industrial activities directly connected with war work. This is also true in other territory where similar enterprises are established. A general demand for conduit, with low stocks and tardy deliveries, is noted at the principal points of distribution. There is a call for new line material hard to meet. Wire sales in the smaller sizes exceed last year's volume, with unusual activity in No. 14 and circular-mil sizes. Transactions in domestic appliances show an increase.

The following sales on government account are officially reported: The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., and the Robbins & Myers Company of Springfield, Ohio, were recently awarded contracts by the United States Army Medical Corps for motor fans. The Quartermasters' Department placed an order with the Peerless Light Company of New York City for flashlights. The General Engineering Depot made contracts with the following: Westinghouse Electric & Manufacturing Company, motors; Western Electric Company of New York City, hydrometers and miconite plate; National Electric Supply Company, brake lining, rivets, patch and heat units, vulcanizers and electric fans; Sangamo Electric Company of Springfield, Ill., watt-hour meters; General Electric Company of Schenectady, N. Y., magnetos, fuses, voltmeters and other electrical material; Willard Storage Battery Company of Cleveland, Ohio, batteries.

President Wilson in an open letter has requested all employers engaged in war work to refrain, after Aug. 1, from recruiting unskilled labor excepting through the United States Employment Service. Labor conditions are unsatisfactory in spite of advancing wages, strikes and threatened strikes being numerous.

NEW YORK

No diminution in the volume of sales for the week on account of the recent advances in price is noticeable. There is evidence that jobbers, anticipating greater transportation difficulties in the fall than now, are placing orders for as large a quantity of staple goods as the manufacturers will accept. It is understood, however, that the only quotations made are those that prevail at the time of shipment.

Just what effect the increased freight rates which went into effect on Tuesday will have on the price of material and finished goods is not yet determined. The increased express rates of about 10 per cent date from Monday next, July 1. Labor shortage continues to be bothersome.

Collections are more than fair. Credits are carefully looked after. Trade acceptances are coming into more general use.

MOTORS.—On special designs of from 50 hp. to 100 hp. deliveries are very poor. Only on government orders is a preference given on priority delivery.

POLE HARDWARE.—Demand is strong, but it is getting more difficult to obtain an adequate supply. No change in prices has occurred during the week, but distributers state that revisions on a higher level may be expected.

HOUSEHOLD SPECIALTIES.—The increasing scarcity of domestic help and the trouble of holding employees is having a beneficial influence on the growing demand and enlarged sales of electric washing and ironing machines.

Sewing machines also are active, with factory deliveries weak and uncertain. Dealers and department stores have ordered freely in anticipation of the higher scale going into effect on sewing machines on Monday.

COLLECTIONS.—One jobber selling almost entirely to the government reports collections on a fifty-day to fifty-five-day basis, which is about ten days longer than normal.

CONDUIT.—While conduit is in scant supply, sizes above ¾ in. are reported to be almost impossible to get. The statement that one jobber who carries a diversified stock of staples had a large quantity of conduit on hand was generally questioned. It is said that, outside of small orders which can be filled by shopping around, an order for 25,000 ft. of all sizes, if it could be handled, would command any price the seller might name.

SCHEDULE MATERIAL.—An active demand is reported for the entire line. No further change in prices is reported. Deliveries are backward and practically unaltered.

PORCELAIN.—The supply is short, and it is hard to have stocks replenished to anything near normal. Another price advance is looked for at almost any time.

LAMPS.—With accumulated stocks on standard sizes in the factories, though they are still behind on miniatures and flashlamps, a leading jobber states they never have caught up on candelabra lamps. Government orders are absorbing a large portion of the standard lamp output.

CONDULETS.—All sizes are in strong demand, with stocks low and replenishment no easy matter. No change in prices has occurred.

CHICAGO

Further encouragement was afforded those who are wishing for munition factories to come to Chicago by news that a considerable deal in real estate has been made at Riverdale, near that city, for a factory to cover several acres of ground. Ordinary building activities are still very weak. The wiring of old buildings, to which the attention of contractors has been diverted, still keeps ahead of general construction. On every side contractors in the city of Chicago are being advised to take up retail merchandising in connection with their construction activities. Among the manufacturers the steel situation, especially in regard to steel requirements for 1919, is all-absorbing. An authority in Chicago this week expressed the opinion that, even with the present demands of General Pershing, it would be possible for most of the factories to get pretty nearly all of their requirements for 1918 through the employment of seconds. The fact that steel prices did not advance on Friday, June 21, is taken to indicate that a steady influence will be exerted on the market. On the other hand, it is believed that the importance of the freight increase has not been fully appreciated. The discussion on trade acceptances at the meeting of electrical credit men in Chicago brought out that about 70 per cent of the members of this association are using the trade acceptance with results which range from fair to excellent.

Customers of jobbers who carry stocks went into the market before the freight increase took effect in some instances to buy conduit, rubber-covered wire, porcelain and other stock items, so that sales for the week just before the increase went into effect were a little higher than usual. There were no price changes this week, but further advances are expected when a full realization of the effect of the freight situation is reached. In such an item as sockets, for instance, it must be figured that there will be an increase of 25 per cent on the freight rate on the socket itself; but in addition to this there will be increased freight to pay on every product that goes into the socket.

FANS.—The cool weather of the week has interfered with an active movement for fans.

CONDUIT.—Galvanized conduit is especially scarce. Some of the jobbers have stocks of black.

DRY BATTERIES.—The prices on dry batteries have been increased to take care of the increased cost of freight. This amounts to about ¼ cent per dry battery for "Red Seal" brand in Chicago.

TAPE.—The extraordinary demand for tape has placed most Chicago factories two months behind on delivery. Government orders are partly responsible.

BUSBAR SUPPORTS AND DISCONNECT SWITCHES.—Industrial companies are taking large quantities.

POTHEADS.—An active movement through central stations is taking place in potheads.

ELECTRIC IRONS.—The special sales week in electric irons was very successful.

RECEPTACLES. — The "more-sockets-for-more-service" campaign, now being promoted, is expected to stimulate the demand.

BOSTON

Business holds up well, with the usual war foundation and an increasing tendency toward the curtailment of non-essential industries. The government buying program seems inexhaustible. Collections are fairly good, but the electrical contractor's position is not so satisfactory as is desirable, owing to the extremely small amount of new construction work along building lines. It appears that the creation of an industrial barred zone in the East will limit development work more and more in war industries to the intensifying of production in existing plants. Here is a field for efficiency engineering, however, which will demand a good deal of electrical material in its cultivation.

FANS.—Unseasonably cold weather is holding back fan sales, and retail stocks are virtually standing still. Meanwhile the final shipments from the factories are preparing a jobbers' reserve.

FIRE-ALARM TELEGRAPH APPARATUS.—Municipal buying is rather below normal, although many systems now in service are relatively out of date and should be replaced. Curtailment by cities and towns is the cause of light business. The government, on the other hand, is installing a large amount of protective equipment in its plants, arsenals and navy yards. Fire protection in shipyards is an extremely live subject and is receiving the attention of engineers in many localities. Price advances have been slower than in many lines, probably not over 25 per cent in the last two years, but a further advance of about 10 per cent is expected in the near future.

MOTORS.—Shipments ordered six or eight months ago are now coming in, but the demand is so heavy that stocks are soon depleted. The country is being combed for large-sized units. A recent order for four 350-hp. motors was filled through Denver, Col., the units being rewound at St. Louis and shipped to Bridgeport, Conn., for munitions plant operation. Second-hand motor prices are following the same upward trend observed in new machinery. Small motors are fairly easy to obtain, at least in odd sizes. An inquiry at the end of last week for twelve 50-hp. machines for immediate delivery could not be satisfied.

INSULATING MATERIAL.—Ebony wood advanced in price about 10 per cent within a fortnight, and stocks are very low, owing to government demands. Prices hold firm on plain asbestos, with little opportunity to accumulate stocks of any real size. Large stocks of fiber conduit are on hand against the long-deferred time of central-station expansion. Government work takes less of this material than is often supposed, only about 2000 ft. being required even in a plant like the destroyer plant at Squantum.

INTERIOR TELEPHONE APPARATUS. — Industrial sales are at low volume, except in war plants working under great time pressure.

STORAGE BATTERIES.—Deliveries are hard to obtain, and stocks are accordingly low.

CONDUIT.—Stricter limitation of shipments to orders carrying priority numbers is the order of the day. Stocks are spotty, and the trend is toward reduced totals. It is difficult to see how an advance in price can be much longer postponed, in view of increased freight rates and the enormous demand for steel.

BATTERY-CHARGING EQUIPMENT.—Small motor-generators are in heavy demand, and controlling equipment, while not maintained in sizable or complete stocks, is being supplied on a four weeks' delivery basis. Some delay in the delivery of meters for panel service is being met.

ATLANTA

The Southeastern Section of the N. E. L. A. meeting at Atlanta, Ga., is the chief item of interest in the industry this week. Although in some cases central stations have been allowed to increase rates, a large number of petitions are being heard or waiting to be heard before the various state commissions. Monthly statements show that net earnings are growing less as the year advances, and while the commissions realize these conditions it is not expected that their work can be expedited unless the federal government suggests immediate relief in the way of surcharges.

Official announcement was authorized to the effect that Camp Hancock, Augusta, Ga., will be transferred from a tented to a regular cantonment type of army post, and at the same time an additional camp will be constructed with a new name. Both camps will house approximately 90,000 men for machine-gun and ordnance training. Preliminary estimates place expenditures for this work at $4,000,000. Docks, terminals and warehouses will be constructed for the government at New Orleans, La., costing $10,000,000. The Southern Truck & Car Corporation of Greensboro, N. C., has been organized with a capitalization of $1,000,000 for the manufacture of 1-ton motor trucks. The International Graphelt Corporation of Birmingham, Ala., with a capital of $1,000,000, will develop graphite properties in Alabama.

HEATING APPLIANCES.—Irons, grills and toasters are moving briskly, especially in Georgia and Florida. One manufacturer reports business for the first five months as being away ahead of the same period last year and the value per order 40 per cent higher.

TRANSFORMERS.—The demand for the larger power type from central stations has fallen off considerably. The call for the distributing type, however, remains steady. Factory facilities have improved and local stocks are coming up, even in the face of present transportation difficulties. A substantial order from a large central station, covering subway type, was reported by one manufacturer.

WIRE AND CABLE.—A power company this week has asked for bids on a large quantity of varnished-cambric lead-covered cable. The week has witnessed a big demand for both rubber-covered and weatherproof from No. 14 up to circular-mill sizes. Deliveries on the smaller sizes are being made from stock, and promises of four to six weeks on the heavier cables are being made.

SEATTLE

The volume of sales by both jobbers and dealers continues at high levels, although extraordinarily large sales are lacking. The volume to shipyards and allied plants is sustained, as were sales pertinent to new construction. Transportation congestion, both outgoing and incoming, is extremely irritating and is arousing constant worry and embarrassment. The labor situation shows no improvement.

The War Finance Corporation has granted the Northwestern Electric Company of Portland, Ore., a loan of $1,000,000 to complete its steam-electric plant to serve the shipyards' and industrials' increasing needs. In the past week a contract was signed for the biggest job of telephone construction ever attempted in Clallam County. The Board of Public Works of Seattle has opened bids for furnishing generator sets, motors, transformers, poles, etc., costing approximately $70,000. The Lewis County Commissioners have granted a franchise to the Central Light & Manufacturing Company to erect power lines in about six towns and along highways.

The wooden shipyard of Seattle, with six ways, has changed hands. Immediate improvements and enlargements are planned. Work doubling the capacity of Tacoma's steel shipyard to eight ways is started. The improvement also includes the construction of a 300-room hotel, dining and recreation hall, hospital, offices, machine shops and foundry, to cost approximately $500,000. The housing campaign in Portland involves the construction of about 600 dwellings.

The embargo against all shipments of fir lumber for cross-arms, wood stave pipe, etc., issued by the Fir Production Board, is believed to be only temporary.

CONDUIT.—The demand is steadily increasing with the continued building of new shipyards and the expansion of established plants. Jobbers generally report low stocks, increasing demands and tardy deliveries. The policy of substituting in colors and sizes is relieving the local situation.

PORCELAIN.—The demand shows a continued upward trend which is met with insufficient stocks. Deliveries are extremely slow with no improvement in sight. Calls for new line construction are hard to meet. Industrial demands have priority rights and at present practically absorb the supply.

WIRE.—The volume of sales the past two weeks shows a decided increase from industrial and constructional sources. The amount of smaller sizes, used in residence construction, far exceeds the demands of years past. Shortages of all sizes exist. Shipments are irregular and unsatisfactory. Prices show no increase of moment.

MOTORS.—The larger sizes are extremely hard to obtain, but the smaller sizes are coming through comparatively quite well. The demand for larger sizes has not been heavy the past three weeks, but the demand for the smaller sizes continues brisk. Jobbers as a whole report stocks shot to pieces with no early signs of improvement. The demand from the shipyards is improving, although the improvement is felt to be only temporary. Stocks are being replenished slowly. The industrial demand continues large.

DOMESTIC APPLIANCES.—Washing machines were prime movers last week and the movement is growing. Jobbers believe a shortage of female help will further increase sales. Sales of electric ranges, irons, etc., are also on the increase. Demands are met to date but an acute shortage is imminent unless deliveries improve.

SAN FRANCISCO

Reviewing the present electrical conditions, one finds ordinary staple house-wiring business to be a small percentage of its normal volume. Dealers' counter business is poor, although there is a brisk sale for larger household devices. Industrial and government business is large, although mostly covering maintenance material rather than new construction, for the time being at least. There is no change in the status of credits or in the character of collections.

Los Angeles building permits for May totaled 639, valued at $1,306,000. The workmen's housing question is growing more serious. Fifty bungalows are to be erected near Lodi, costing from $1,500 to $2,000 each. One hundred cottages, valued at from $2,000 to $3,000 each, are to be erected in the vicinity of Vallejo, the seat of the great government navy yard of Mare Island. Other government work reported covers a quarter-million-dollar marine hospital at the Presidio in San Francisco and the alterations and additional construction at the San Francisco mint. The State of California is receiving bids for the construction of a large State building in Sacramento.

TAPE.—The higher grades of tape have just advanced 10 per cent. The commercial grades of friction tape are now within 25 per cent of the value of rubber tape.

FUSE PLUGS.—Fuse plugs have just advanced 10 per cent, selling now in package lots at 5 cents each on the Pacific Coast to dealers.

FLEXIBLE CONDUIT.—Flexible non-metallic conduit has just advanced 17 per cent. Sales are not running so high as last year by perhaps 15 per cent.

SCHEDULE MATERIAL.—Stocks of switches and similar material have advanced from 15 to 20 per cent, following close on the heels of a 10 per cent advance of a few weeks ago.

TELEPHONE MATERIAL.—Very little extension work is reported on rural telephone lines or by the government lines.

BAKE OVENS.—The general coal situation has produced a number of interesting inquiries for electric bake ovens and large electric ranges. A large electrical equipment has recently been installed in Camp Curry and is reported as being very satisfactory.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List Per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List to + 15%
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List to + 15%
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List to $120.00
Coil to 1000 ft	10% to $100.00
	No. 12 Solid
Less than coil	List to + 15%
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	List to + 20%
Coil to 1000 ft	List to 20%
	No. 12 Solid
Less than coil	List to + 20%
Coil to 1000 ft	List to 20%

Twin-Conductor

	No. 14 Solid
Less than coil	List to + 20%
Coil to 1000 ft	List to 20%
	No. 12 Solid
Less than coil	List to + 20%
Coil to 1000 ft	List to 20%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+ 10% to 24.00c.
1/5 to std. pkg	5% to 19.80c.
Std. pkg.	23% to 18.75c.

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10% to + 20%
1/5 to std. pkg	List to 20%
Std. pkg.	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.285	.295

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3190-.3293	.3290-.33
Barrel lots	.2890-.2995	.2990-.30

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 100 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
3/8-in. s. stp.	List to $82.50	15% to $67.50
3/8-in. d. stp.	List to 84.00	List to 69.00
1/2-in. s. stp.	List to 110.00	15% to 90.00
1/2-in. d. stp.	+10% to 112.00	List to 92.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
1/2-in. single strip	List	$63.75
3/8-in. double strip	78.50-78.75	71.25-85.00
3/8-in. single strip	List	85.00
1/2-in. double strip	105.00	94.50-95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In	List per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
5/16	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00-$49.50	$24.00-$41.25	$28.00-$45.00
1/4-in.—	$30.00-$54.00	$23.00-$33.00	$26.00-$36.00

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$55.00-$60.00	$25.00-$30.00	$22.50-$26.50
1/4-in.—	$60.00-$65.00	$27.00-$32.50	$25.00-$29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 39

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	6% to 12%	10% to 15%
2500 to 5000 lb.	6% to 14%	11% to 17%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 to 3 in.
Less than 2500 lb.	6.8% to 8.9%	9.8% to 10.3%
2500-5000 lb.	7.3% to 9.3%	11.8% to 12.7%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$5.00 to $6.00
Discount	25% to 30%

CHICAGO

List price	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

	Std. Pkg.	List
250-Volt		
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10% to 30%
1/5 to std. pkg.	20% to 41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	List to $5.50
1/5 to std. pkg.	15% to $4.75

Standard packages, 500. List, each $0.07

CHICAGO

	Per to 100 Net
Less than 1/5 to std. pkg.	$7.00
1/5 to std. pkg.	5.75

Standard packages, 500. List, each $0.07

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3½-in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾-in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4⅝-in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg. ..... List
Std. pkg. 10%

DISCOUNT—CHICAGO

Less than std. pkg. ..... List
Std. pkg. 10%

LAMP CORD

Cotton Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$29.13 to $33.80
Coil to 1000 ft.	26.22 to 28.73

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft)	$29.00 to $30.00
Coil to 1000 ft.	21.50 to 25.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100 ..... $21.75

CHICAGO

Net per 100 ..... $21.75 to $30.00

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½ 4 S	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	30% to 33%	20% to 27%
$10.00 to $50.00 list	35% to 42%	25% to 37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. ..... 5% to 10%
1/5 to std. pkg. ..... 15% to 20%
Std. pkg. ..... 25% to 30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg. 10%
1/5 to std. pkg. 20%
Std. pkg 30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80 to $20.00
1/5 to std. pkg.	14.80 to 20 00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500 5½ N.C.	Std. Pkg. 4000 N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$11.85	$30.70 to $30.75
1/5 to std. pkg.	11.10	24.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500 5½ N.C.	Std. Pkg. 4000 N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$11.85 to $12.00	$20.75 to $30.75
1/5 to std. pkg.	11.10	24.20 to 40.80

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets.	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. ..... + 10%
1/5 to std. pkg. 5%

NET PER 100—CHICAGO

Less than 1/5 std. pkg. ..... 10% to 29.70 cts.
1/5 std. pkg. ..... 20% to 26.40 cts.

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade	Low Grade
Less than $10 list	List to + 10%	List to 10%
$10 to $25 list	List to 15%	10% to 25%
$25 to $50 list	10% to 20%	15% to 28%

DISCOUNT—CHICAGO

	High Grade	Low Grade
Less than $10 list	+ 5%	5% to + 5%
$10 to $25 list	11% to + 10%	8% to 16%
$25 to $50 list	14% to + 14%	16% to 24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Cont'd

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. ..... + 10%
1/5 to std. pkg. 5%
Std. pkg. 23%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg. ..... List to + 20%
1/5 to std. pkg. ..... List to 20%
Std. pkg. ..... List to 28%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List, Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List to 20%	List
$2.00 to $10.00 list	10% to 25%	5%
$10.00 to $50.00 list	20% to 30%	10%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25% to 50%	20% to 40%
$2.00 to $10.00 list	25% to 64%	20% to 52%
$10.00 to $50.00 list	25%	20%

TOASTERS, UPRIGHT

NEW YORK

List price ..... $5.00 to $6.00
Discount ..... 25% to 30%

CHICAGO

List price ..... $5.00 to $6.00
Discount ..... 25% to 30%

WIRE ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.42½-$0.50
No. 18, full spools	0.40¼-0.45

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.57½-$0.65
No. 18, full spools	0.50½- 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00-$18.00	$12.00-$14.00	$10 50-$12 50
12	21.78- 26.25	19.97- 20.62	16.13- 16.33
10	32.47- 33.18	27.67- 28.65	21.50- 22.40
8	38.61- 51.24	35.10- 40.26	30.01- 31.47
6	55.60- 81.06	50.04- 63.69	47.54- 50.79

CHICAGO

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00-$19.00	$13.00-$14.00	$11.50-$12.50
12	25.33- 27.53	21.78- 25.33	14.97- 22.02
10	33.02- 35.21	30.03- 30.48	27.66- 28.23
8	46.09- 49.14	41.98- 42.54	35.10- 39.42
6	54.14- 67.28	61.76- 72.12	52.78- 60.10

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$33.25 to $37.85
25 to 50 lb.	33.25 to 37.85
50 to 100 lb.	32.25 to 37.10

CHICAGO

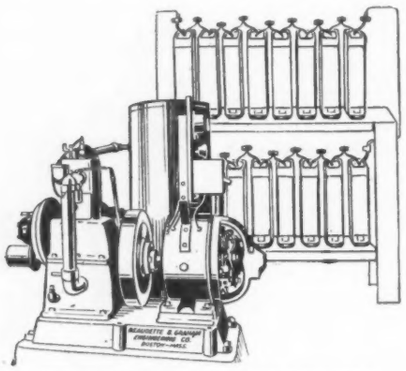
	Per 100 Lb. Net
Less than 25 lb.	$37.00 to $37.43
25 to 50 lb.	36.00 to 36.43
50 to 100 lb.	35.00 to 35.42

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Farm Lighting Plant of Many Uses

Additional devices such as water pumps, milking machines, etc., can be operated by a direct-connected farm lighting plant that is being marketed by the Beaudette & Graham Engineering Company, 10 Lincoln Street, Boston. This is accomplished by means of a small extra pulley attached to the extension shaft of the engine which permits a belt to be used. The multipolar ball-bearing generator is driven by a four-cycle, 1100-r.p.m., 2½-hp. water-cooled gasoline engine and is semi-automatic.



EXTRA PULLEY ON SHAFT DELIVERS MECHANICAL ENERGY

Combination Steam and Electric Radiator

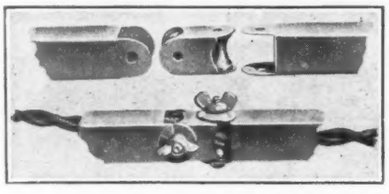
Heat can easily be obtained from a combination steam-electric radiator which in reality is an electrically operated steam-flash generator. This radiator is marketed by the Electro Steam Radiator Company, 125 South Wells Street, Chicago. The device has the same appearance as the steam or hot-water radiator. The radiator is tightly sealed under a vacuum so that the same water is used over and over again as the heat-producing medium. The heating element used in the radiator is manufactured by the General Electric Company of Schenectady, N. Y.

Washing Machine for Use with Small Lighting Plant

Some of the washing machines manufactured by the Grinnell Washing Machine Company of Grinnell, Iowa, can now be used with the ordinary Delco lighting outfit. They are equipped with a special Emerson electric motor rated at 32 volts, 8 amp. and 1600 r.p.m. The machine is run by means of an internal gear connected directly to the motor. The manufacturers claim that they are economical in the use of electricity. The wringer of this washer not only swings but locks in position and is driven directly by the main shaft. Drains eliminate the necessity of lifting and stooping in the use of the washer.

Adjustable Fixture for Industrial Use

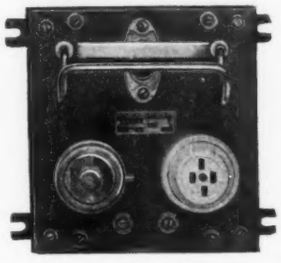
A line of adjustable fixtures for industrial use has been developed and placed upon the market by the American Fixture Company, 232 West Water Street, Milwaukee, Wis. These fixtures are simple in design and are capable of many variations. Both of the parts are of sheet steel, and they are welded together by acetylene. With a stock of various sizes it is possible to make up very quickly almost any style and size of fixture desired. The fixture may be attached to the ceiling, wall or floor, at the same time allowing the light to be directed in any direction by use of the universal joint. Furthermore, the manufacturers state that once the fixture has been placed in a certain position it will retain that position until it is manually changed.



ANY STYLE OF FIXTURE CAN BE MADE FROM STOCK PARTS

Automatic Rack for Electric Soldering Irons

Electric soldering irons which are left lying on a bench or other convenient place when not in use gather dirt and become a hazard. If the current is turned off, the iron cools down to such a degree that considerable delay is caused when the iron is again desired for use. To overcome this the Cutler-Hammer Manufacturing Company of Milwaukee and New York has recently developed an automatic soldering iron rack and control panel which is said to decrease the amount of energy taken by the iron. It keeps the iron from overheating, prevents burn-outs and saves energy. The rack consists of a small slate panel arranged for wall mounting and carrying a support for the iron which acts on the principle of the telephone receiver hook. When the iron rests on the support or hook it bears the support down and resistance which is mounted on the back of the panel is inserted in circuit with the iron. Taking the weight from the hook disconnects the resistance from the soldering iron circuit and allows full current to flow. Below the hook, on the same panel, there are a push-button switch and a receptacle to which the plug of the soldering iron cord is connected.



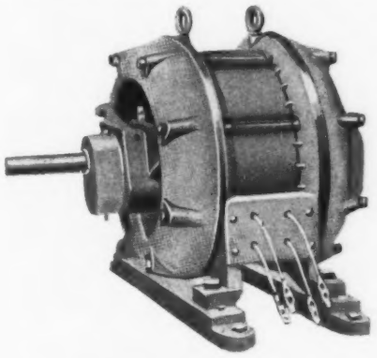
IRON KEPT WARM WHEN NOT IN USE

The little panel is therefore a complete switchboard which may be mounted on the wall or machine within reach of the workman. When not in use and at night the switch is snapped "off," which completely opens the circuit to the iron. These automatic racks are designed for use with Cutler-Hammer soldering irons, but may be used with similar types as well.

Well-Balanced Induction Motor

Conservatism of design is a feature that is claimed for an induction motor manufactured by the Cleveland Electric Motor Company, 5519 Euclid Avenue, Cleveland, Ohio. It is designed so to proportion the various electrical features as to secure the motor best suited for general service conditions. No characteristic has been unduly developed at the expense of other qualities, but the whole design has been well balanced. The manufacturers claim that high efficiency and power factor are obtained; the starting torque is high and the maximum or pull-out torque and overload capacity are very liberal. The air gap has been made as large as possible for good design. The motor is very efficiently ventilated and has low operating temperatures. The constant-speed squirrel-cage induction motor illustrated is designated as type "M." For large starting torque or where the current is to be kept at a

minimum value the wound-rotor type of motor is used. This motor is designated as type "MW." Both types are made in ratings of from 2 hp. to 50 hp. in standard frequencies of 60, 50, 40 and 25 cycles for either two-phase or three-phase and 110, 220 or 550-volt service. Continuously rated motors will carry full load for twenty-four hours



MOTOR IS WELL VENTILATED

with a temperature rise of not over 40 deg. C. and 25 per cent overload for two hours with a rise of 55 deg. C.

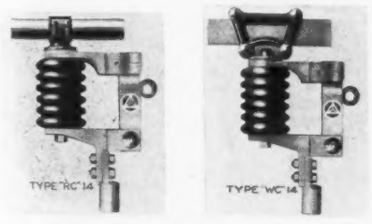
Powerful currents of air are set up by the rotor fans. These currents are directed by the bracket housing through the rotor, winding around and over the center coils, and out through the ventilation ducts provided by the fingers on the stator end ring. All parts of the motor are effectively exposed to this ventilation, and cooling does not depend upon radiation alone.

Generator for Charging Storage Batteries

Storage batteries for lighting automobiles and motorcycles can be efficiently charged by means of a generator recently placed upon the market by the Carleton Company, 170 Summer Street, Boston, Mass. The generator is designed to charge any 6-volt battery, but its output at normal speed is 7 volts and 7 amp.

Bus-Type Disconnecting Switches

Flexible disconnecting switches that can be attached directly to the busbar are shown in the accompanying illus-

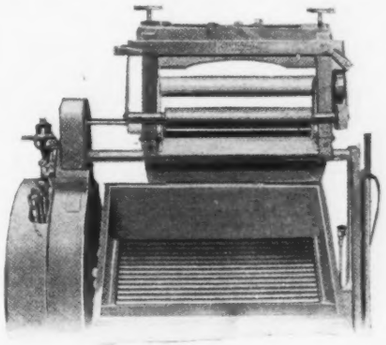


SWITCH BLADE CAN BE PLACED IN ANY POSITION

tration as manufactured by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. These switches are made for attaching to either round or flat busbars with various ratings as desired. By means of adjustable clamps they may be held in any position on the busbars and they have terminal connection lugs that can be clamped to either the front or the rear surface of the load switch terminal. The switch blades can be placed in line with or at right angles to the bus or in any intermediate position desired.

Washing Machine with Safety Features

A washing machine equipped with an automatic safety stop, an automatic conveyor and a safety release is being manufactured by the Chicago Dryer Company, 624-630 South Wabash Avenue, Chicago. The driving mechanism of the wringer is so arranged that in event of clothes winding around the rubber rolls the wringer is automatically thrown out of gear and stops instantly. There is no necessity for touching levers of any kind in an emergency. The mechanism is adjustable, and adjustment may be made so that the wringer will stop on a light, medium



WRINGER AUTOMATICALLY STOPS IF ANYTHING IS WRONG

or heavy pressure. By pushing the lever at the top of the wringer the cross-bar is instantly released and the top rubber roll is raised about 6 in. (15.2 cm.) above the lower roll. This safety release is another feature. The automatic conveyor consists of a revolving roll in front of the rolls of the wringer. As this conveyor revolves it carries the clothes into the rubber rolls of the wringer, thus eliminating the necessity of bringing the hands or fingers close to the rubber rolls when feeding. A 1/6-hp. motor is used to drive these machines.

Direct-Connected Motor-Driven Pump

For obtaining vacuum in heating plants the Viking Pump Company, Cedar Falls, Iowa, is manufacturing a line of motor-driven, direct-connected pumps. The pump with a condensation tank is installed in the return pipe line and arranged so that when the tank becomes filled to a certain level the switch automatically starts the pump and operates it until the tank is emptied. The switch then breaks the circuit. It is claimed that these pumps handle liquids of any viscosity, ranging from ether and gasoline to the heaviest liquid.

Motor-Driven Lawn Mower

A lawn mower in which the 20-in. (51-cm.) blades are driven by a 1/6-hp. electric motor is being manufactured by the Palmer Electric Company,

GRASS MAY BE CUT WITH A MINIMUM PHYSICAL EFFORT

50 Park Place, Detroit, Mich. The motor is also made in another style, using ¼ hp. and driving 31-in. (76-cm.) blades. On this machine the motor is belted to the shaft on which the blades are attached, which has no connection with the wheels of the machine. The machine must be manually pushed, but the motor revolves the blades so that the only physical effort required is that of getting the mower over the ground. Energy is supplied to the motor through a long, flexible waterproof cord.

Automobile Valve Grinder

Valves for automobiles can be efficiently and smoothly ground by means of a valve grinder that has been placed upon the market by the Stenman Electric Valve Grinder Company, Inc., 42 Southbridge Street, Worcester, Mass. The manufacturers claim that this grinder will operate on any type of valve made and will give a perfect seal in a very short time. A feature of the grinder is the oscillating motion produced, which has a frequency of 800 oscillations per minute.

Inclosed Safety Switch

An inclosed safety switch approved by the Industrial Accident Commission of California and the Department of Electricity of the city of San Francisco is being manufactured by the California Electrical Construction Company, 641 Mission Street, San Francisco, Cal. The switches are simple, safe, self-locking and cannot get out of order, according to the manufacturers. They are known as the "Ceco" and are inclosed in a black enameled box with hinged cover. Its construction is such that when the switch is closed the box is locked, and to open the box the switch must first be opened.

Trade Notes

THE GARDNER ELECTRICAL MANUFACTURING COMPANY has removed from Bay Point to Emeryville, Cal.

BRITAIN'S ELECTRIC MOTOR COMPANY is the new name of the Langdon-Davies Electric Motor Company of London, Eng.

THE EDISON STORAGE BATTERY COMPANY of Orange, N. J., has opened a sales office at 740 Land Title Building, Philadelphia. J. A. Hurst, sales engineer of the Edison company, is in charge.

THE WAR TRADE BOARD of Washington, D. C., in supplement No. 4 of May 31, publishes a "Cumulative Supplement to Enemy Trading List, Revised." It contains additions, removals and corrections from March 15 to May 31.

THOMAS A. EDISON, INC., of Orange, N. J., on July 1 will inaugurate an eight-hour day with time and a half for overtime. This means a wage increase of $500,000 and affects 8000 employees. The plant was formerly on a ten-hour basis.

E. M. RAETZ of the Foster-Raetz Electric Company of Rochester, Minn., has associated himself with Paul D. Richardson, Minneapolis, Minn., in the sale of the Stromberg electric time systems and the "Autocall" signal system for the Northwest.

THE WESTINGHOUSE ELECTRIC PRODUCTS COMPANY, formerly operating under the name of the Copeman Electric Stove Company, has removed its plant from Flint, Mich., to Mansfield, Ohio. The purchase of the Mansfield property was referred to in a previous issue of the ELECTRICAL WORLD.

THE AMERICAN CHAMBER OF COMMERCE of Paris, France, in its fortnightly information pamphlet, publishes a list of articles which are prohibited for exportation and re-exportation. Among other commodities is given that of compositions of products for electric insulation and tubes and pipes for boilers.

THE SMITH & HEMENWAY CO., INC., of New York City, whose plant at Irvington, N. J., is very largely given over to the making of tools for the government, is completing another building. New machinery of the latest design is being installed. Late last year the factory in Hill, N. H., added a new building.

THE LALLEY-WILSON ELECTRIC COMPANY of Omaha, Neb., distributer for the Lalley electric light and power plants for farm use in four States, desires to secure catalogs, literature and jobbers' prices on 32-volt motors and 32-volt appliances of all kinds, together with lighting fixtures and wiring appliances suitable for 32-volt plants. The company is preparing its first catalog.

THE CORN EXCHANGE NATIONAL BANK of Philadelphia has issued a pamphlet entitled "What Other Nations Have Done to Help Their Disabled Soldiers and Sailors." The information is compiled largely from reports and publications issued by the authority of the British Ministry of Pensions, and includes also data from Belgian, French and American sources.

THE AVERY & LOEB ELECTRICAL COMPANY of Columbus, Ohio, has discontinued its electrical contracting business, according to reports, and is devoting its energies to the jobbing of supplies and fixtures. This has required additional room, and for the purpose the company has acquired 2100 ft. more floor space, making 30,000 sq. ft. in all and covering five floors and basement of the building occupied. The sales organization has been augmented by several young women.

THE BOOTH-HALL COMPANY of Chicago, metallurgists, engineers and builders of electric furnaces, has just concluded arrangements with the Bradford-Ackermann Corporation, 30 East Forty-second Street, New York City, to take entire charge of sales in the eastern section of the United States. C. C. Bradford and A. H. Ackermann are both graduate electrical engineers. Mr. Ackermann was formerly vice-president and general manager of the United States Heat & Light Corporation, Niagara Falls, N. Y., and Mr. Bradford was general sales manager of the same company.

KOCH & SANDIDGE of Chicago is a new firm handling the sales engineering work for the "Jiffy" cutting tools and similar products made by the Universal Tool & Appliance Company of Milwaukee, Wis. Paul W. Koch, although a partner in the business, will remain active as president and general manager of the Electrical Sales Engineers, Inc., of Chicago. He is a graduate of Illinois University. John H. Sandidge has been connected with the Cooper Hewitt Electric Company for more than six years, being sales manager in the Chicago district for five years and recently Wisconsin manager with offices in Milwaukee. He was at one time with the Commonwealth Edison Company as illuminating engineer for its contract department. Mr. Sandidge is a graduate of Tulane University. He will also become associated with the Electrical Sales Engineers, Inc., in selling products of the Condit Electrical Manufacturing Company.

THE CONTINENTAL PIPE MANUFACTURING COMPANY has purchased the plants and good will of the following long-established concerns: Pacific Coast Pipe Company, Seattle; Washington Pipe & Foundry Company, Tacoma; National Tank & Pipe Company (pipe department), Portland; Portland Wood Pipe Company, Portland. The general offices of the company are at 4515 Fourteenth Avenue, N. W., Seattle, Wash. The Eastern offices of the company are in the Woolworth Building, New York City. Plants for the manufacture of wire-wound and continuous-stave pipe are operated in Seattle, Tacoma and Portland. Officers of the Continental company are: Leo H. Long, president, formerly president of the Washington Pipe & Foundry Company; T. B. Garrison, vice-president, formerly president of the Pacific Coast Pipe Company; F. M. Kirsch, vice-president, formerly vice-president of the National Tank & Pipe Company; W. E. Russell, secretary, formerly vice-president of the Washington Pipe & Foundry Company, and L. Murray Grant, general manager. Mr. Grant was chief engineer of the Pacific Coast Pipe Company. A strong technical staff has been built up by the new organization, the following well-known engineers being included, the former connections of each being indicated: H. D. Coale, National Tank & Pipe Company; R. B. Fulton, Pacific Coast Pipe Company; E. J. Bartells, Pacific Creosoting Company, and Frank C. Kelsey, who takes the New York offices of the Continental Pipe Manufacturing Company in the Woolworth Building.

Trade Publications

MOTORS.—The Wagner Electric Manufacturing Company, St. Louis, Mo., has issued a calendar poster.

LIGHTING UNITS.—"Peerlites" lighting units are described and illustrated in a circular that is being distributed by the Peerless Light Company, Chicago.

SUPPORTING STRIPS.—The Ohio Distributing Company, Chicago, Ill., has issued a circular describing the Kruse metal supporting strips for switchboxes.

CLAMPS AND SWITCHES.—W. N. Matthews & Brother of St. Louis, Mo., have issued a circular describing and illustrating their "Fuswitch" and boltless clamps.

DESK AND PIANO LAMPS.—"Verdelite" desk and piano lamps are described in a booklet that has been issued by the Faries Manufacturing Company of Decatur, Ill.

DISCONNECTING HANGARS.—"The Human Nature Side of Lamp Cleaning" is the title of a circular being distributed by the Thompson Electric Company, Cleveland, Ohio.

WASHING MACHINES.—The "1900" washing machine is described and illustrated in a circular being distributed by Wallace B. Hart, 46 East Forty-first Street, New York City.

PLACARDS.—The Cleveland service office of the Burke Electric Company, Erie, Pa., is distributing a placard emphasizing the fact that electricity should be saved whenever possible.

ELECTRIC SPECIALTIES.—The Anderson Electric Specialty Company, 118 South Clinton Street, Chicago, has published list No. 2B, describing and illustrating the Anderson dental and laboratory appliances.

PAPER.—The Mitchell-Rand Manufacturing Company, 99 John Street, New York, is circulating a card to which is attached a sample of "Tuftex" red-rope paper for use in armature slots and various other places in generators and motors.

BALL BEARINGS.—The U. S. Ball Bearing Manufacturing Company, Chicago, has compiled and is distributing some data sheets of information regarding dimensions of all types of Strom bearings. Engineering data and other information of interest are also included in this catalog.

POCKET WIRING CHART.—The engineering department of the National Lamp Works of the General Electric Company has issued a wiring chart for use in selecting the proper size of wire for country home-lighting installations. This chart, together with installation suggestions for country home lighting, is made in a convenient pocket size and is contained in a protecting envelope.

BALL BEARINGS.—The first edition of the "New Departure Ball Bearing Manual," which is a practical guide for users of ball bearings is being distributed by the New Departure Manufacturing Company of Bristol, Conn. This is a complete and concise treatise on ball bearings and discusses the best installation practice and also improved methods of lubrication and adjustments. It includes full descriptions and dimensions of the "New Departure" double-row and single-row "Radax" magneto ball bearings.

WROUGHT-IRON PIPE.—A dot chart showing the corrosion of iron versus steel pipe in hot-water mains has been compiled by the A. M. Byers Company, 235 Water Street, Pittsburgh, Pa. This chart is based on a recent investigation of the hot-water lines in 125 buildings. Brass was used in about thirty-five of these buildings, steel in twenty-five and iron in sixty-five. All the records obtained, giving name and location of each of the buildings investigated, are contained in Byers Bulletin No. 30, which is also being distributed.

New Incorporations

THE GARBER (OKLA.) LIGHT & ICE COMPANY has been incorporated with a capital stock of $20,000 by William Musser and others.

THE MASSILLON (OHIO) ENGINEERING & ELECTRIC COMPANY has been incorporated with a capital stock of $15,000 by J. E. and J. M. Lewis.

THE GLEN BROOK POWER COMPANY of Munfordville, Ky., has been incorporated with a capital stock of $30,000 by R. D. Lane, C. R. Garden and H. A. Watkins.

THE BELTHOOVER ELECTRIC COMPANY of Cincinnati, Ohio, has been incorporated with a capital stock of $20,000 by Charles M. Belthoover, John D. Belthoover, George M. Belthoover and others.

THE LOUISVILLE (KY.) STORAGE BATTERY COMPANY has been chartered with a capital stock of $15,000 by W. G. Heist, A. G. Heist and Walter Huffaker. The company proposes to manufacture storage batteries.

THE BOYLAN & CONROY COMPANY of Geneva, N. Y., has been chartered by H. H. Burdick, C. R. Conroy and W. L. Boylan of Hornell. The company is capitalized at $20,000 and proposes to manufacture farm tractors and electrical accessories.

THE LINN GROVE (IND.) LIGHT & POWER COMPANY has been incorporated by Harry Meshberger, Rufus Meshberger, Albert A. Yordy, George S. Gottschalk and Michael Miller. The company is capitalized at $10,000 and proposes to generate and distribute electricity.

THE AREWELL CORPORATION has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,000,000 for the purpose of manufacturing electrical machinery. The incorporators are: M. M. Clancy, C. L. Rimlinger and F. A. Armstrong.

THE FALLS EQUIPMENT COMPANY of Niagara Falls, N. Y., has been incorporated with a capital stock of $100,000 to manufacture electrical, mechanical, heating and lighting equipment. The incorporators are: F. W. Korff, 152 North Transit Street, Lockport, and C. Jones and R. D. Glennie of La Salle.

THE TURBINE ENGINEERING CORPORATION of Buffalo, N. Y., has been incorporated with a capital stock of $100,000 by J. A. Carmon, 47 High Street; C. J. Bush, 549 Grider Street, and A. L. Vickery, Exeter Terrace, Buffalo, N. Y. The company proposes to manufacture engines, machinery, turbines, etc.

W. L. HOLAHAN, INC., of New York, N. Y., has been incorporated by W. L. Holahan, M. A. Holahan, 44 West Sixty-fifth Street, and L. Holahan, 404 West Fifty-eighth Street, New York City. The company is capitalized at $50,000 and proposes to do a general electrical engineering business, trucking business, lumber-merchant, coach-building business, etc.

New England States

NASHUA, N. H.—The New England Power Company has petitioned the City Council for right of way over certain highways for the erection of an electric transmission line to supply electricity to the mills of the Nashua Manufacturing Company.

FAIRHAVEN, VT.—Preparations are being made by the Western Vermont Power & Light Company to rebuild its substation at the plant of the Eureka Slate Company near Lake Bomosen, recently destroyed by fire. The loss is estimated at $5,000.

BOSTON, MASS.—Contract has been awarded by the Navy Department, Washington, D. C., to Chandler & Joyce, 178 High Street, Boston, for alterations and improvements to the power plant at the local navy yard. The cost of the work is estimated at $31,000.

GARDNER, MASS.—The Selectmen have ratified a contract with the Gardner Electric Light Company to furnish 750 electric street lamps at $18.75 each per year. After July 1 gas street lamps (93) will be discontinued, which will be replaced with electric lamps.

HOLYOKE, MASS.—Contract has been awarded by the Worthington Pump & Machinery Corporation for an addition to machine shop, 90 ft. by 200 ft., and addition to foundry, 80 ft. by 180 ft., at its Dean Works in Holyoke.

ORANGE, MASS.—Contract has been awarded by the New Home Sewing Machine Company of Orange for the construction of an addition to its plant, to cost about $75,000. Other large extensions are contemplated by the company.

SHERBORN, MASS.—Plans are being prepared for the erection of a large power plant at the Sherborn Reformatory for Women, to cost about $70,000.

Middle Atlantic States

ALBANY, N. Y.—Bids will be received by W. W. Wotherspoon, superintendent of public works, Capitol, Albany, until July 23, for furnishing, testing and delivering electric capstans and trolley hoists at Pier 6, East River, and West Fifty-third Street Pier, New York City, and electric capstans at the Utica Terminal Pier, under terminal contract No. 109. Plans may be seen and specifications, blank form of contract, etc., may be secured at the above office, at the office of the assistant superintendent of public works for the Middle Division at Syracuse; at the office of the assistant superintendent of public works for the Western division at Rochester, and at the canal office, Spaulding Exchange, Buffalo, N. Y.

BROOKLYN, N. Y.—Paul M. Marko & Company, 1101 Bedford Avenue, have filed notice of increase in capital stock from $50,000 to $75,000, the proceeds to be used for business extensions. The company manufactures storage batteries, etc.

BUFFALO, N. Y.—Plans have been filed by the Buffalo General Electric Company for the construction of an electric power station, 100 ft. by 100 ft., to cost about $25,000.

BUFFALO, N. Y.—Plans have been prepared by the Pullman Company, Marine Bank Building, for the erection of a new power house, to cost about $27,000, at its works at 1770 Broadway.

BUFFALO, N. Y.—The National Aniline & Chemical Company is contemplating the construction of a machine shop, to cost about $85,000, at its plant on Abbott Road. Plans are also being prepared by the company for an addition, 200 ft. by 200 ft., at its works.

GALWAY, N. Y.—Plans are under consideration by the board of managers of the Saratoga County Homestead Sanitarium for the construction of an addition to the power plant at the institution, to cost about $12,000.

GARDENVILLE, N. Y.—Plans are being prepared by the Pennsylvania Railroad Company for the erection of a new engine plant, in connection with additions to its local plant, to cost about $75,000.

NEW YORK, N. Y.—Bids will be received by Thomas J. Drennan, fire commissioner, eleventh floor, Municipal Building, New York City, until July 8, for furnishing cable. Blank forms and further information may be obtained on application to the above office.

NIAGARA FALLS, N. Y.—Plans have been prepared for an addition to the plant of the United States Light & Heat Corporation, 3215 Highland Avenue.

ROCHESTER, N. Y.—The Bridgeford Tool & Machine Works, Winton Road, North, contemplates the construction of a new power plant at its works. A. H. Ingle is president.

WARWICK, N. Y.—A new electric power plant will be built in connection with the group of buildings to be erected at Warwick by the Board of Inebriety, 300 Mulberry Street, New York City. The cost of the buildings is estimated at about $200,000. Chauncey Matlock, 30 East Forty-second Street, New York City, is electrical engineer. Sylvan S. Levy is president of board.

BAYONNE, N. J.—Plans have been prepared by Shattuck & Hussey, 19 South La Salle Street, architects, Chicago, Ill., for the recreation building to be erected and equipped by the Associated Industry of Bayonne, to cost approximately $250,000. The building will be wired for elaborate lighting and for motors required for pumps and ventilating fans.

BURLINGTON, N. J.—Plans are being prepared for a new boiler plant and cold storage room at the State Masonic Home, Jacksonville and Oxhead Roads, to cost about $35,000.

DOVER, N. J.—The new plant of the New Jersey Power & Light Company is nearly completed and will soon be placed in operation. The old station at Boonton will probably be closed down.

HAMBURG, N. J.—At an election held recently the proposal to appropriate $1,500 for lighting the streets of the town was rejected.

HOPEWELL, N. J.—Plans are under consideration by the Borough Council for the installation of new electrically operated pumping equipment at the municipal waterworks.

JERSEY CITY, N. J.—Plans have been filed and contract awarded by the Erie Railroad Company for the construction of a new power house, 35 ft. by 85 ft., at its local works.

KEARNY, N. J.—The Federal Shipbuilding Company has acquired two additional tracts of land adjoining its works at Kearny on the Hackensack River, one 249 ft. by 1472 ft. and the other 250 ft. by 954 ft., which will be used for proposed expansion of the plant.

NEWARK, N. J.—Contract has been awarded by the Nucoa Butter Company, Fourth Street, to the American Concrete Steel Company, 31 Clinton Street, Newark, for the erection of a large power plant, 100 by 100 ft., at its works, to cost about $40,000.

NEWARK, N. J.—Arrangements are being made by the Star Electric Motor Company, 245 New Jersey Railroad Avenue, Newark, for the construction of a new plant to be located at New Jersey Railroad Avenue, Miller and King Streets, to cost about $25,000.

PASSAIC, N. J.—Preliminary plans are being prepared for a new power house, about 80 ft. by 150 ft., for the New York Belting & Packing Company, 91 Chambers Street, to be erected at its local plant on Passaic Street. Lockwood, Greene & Company, 101 Park Avenue, New York, N. Y., are architects and engineers.

POMPTON LAKES, N. J.—Bids will be received by the Borough Council, Pompton Lakes, until July 2 as follows: (1) For the erection of a hydraulic power plant building; (2) two vertical hydraulic turbines; (3) two electric generators and switchboards. Plans and specifications are on file in the office of J. Frank Cornelius, borough clerk. S. Firestone is consulting engineer.

TRENTON, N. J.—Plans are being prepared for the installation of two electrically operated pumping units of 20,000,000 gal. capacity per day at the municipal waterworks station. One of the units is to be of high lift and the other of the low lift type.

CHESTER, PA.—Plans have been completed by Clarence W. Brazer of Chester for the construction of a new town in Tinicum Township, near the Westinghouse Electric & Manufacturing Company's plant near Essington, which will include the erection of 1154 buildings and involve an expenditure of several million dollars.

CHESTER, PA.—The Emergency Fleet Corporation has entered into an agreement with the Public Service Commission for the construction of a new electric railway along the Chester Pike, extending from Chester to Darby, to cost about $1,000,000. This line is to provide transportation facilities for workers in the nearby shipbuilding plants and other industrial plants engaged on government contracts.

MIDDLEBURG, PA.—Plans are being considered by the Juniata Public Service Company, which is negotiating for the purchase of the property of the Middleburg Light, Heat & Power Company, to connect the plant of the State Center Electric Company of State College and the plant of the Juniata Public Service Company. The latter company is planning to increase the output of its plant to about 5000 hp.

NICETOWN, PA.—Considerable new equipment will be required for the new gun plant of the Midvale Steel & Ordnance Company to be erected at Nicetown, which will include 27 electrically driven cranes, as follows: Five 100-ton, one 75-ton, eight 50-ton, one 30-ton, three 25-ton, eight 10-ton, and one 5-ton; also turning lathes, grinders, drills, milling machines, etc.

PHILADELPHIA, PA.—Work has begun on the erection of a transformer building for the Philadelphia Rapid Transit Company, to be erected at Eightieth Street and Eastwick Avenue. The cost of the building is estimated at about $30,000.

PITTSBURGH, PA.—Contract has been placed by the McClintic-Marshall Company for 50 six-ton cranes and eight 10-ton cranes with Manning, Maxwell & Moore for the extensions to be made to its Pottstown fabricating plant. The company also contemplates the purchase of machine tools and additional crane equipment for both its Pottstown and Rankin plants.

WILMINGTON, DEL.—The United States Shipping Board has awarded the contract for the construction of Union Park Gardens at Wilmington, to provide homes for workers employed in the shipyards in the vicinity of Wilmington, to the Lynch Construction Company of Waterbury, at $2,500,000. The contract provides for the installation of public utilities including a water service, gas and electric light systems, etc.

CURTIS BAY, MD.—Plans are being prepared for the erection of three buildings, each 60 ft. by 110 ft., for the Curtis Bay Copper & Iron Works, to be used as machine shops, and other work for the manufacture of copper and iron specialties as well as ship repair parts and castings. The main office of the company will be located at South Baltimore. William F. Cochrane is chief engineer.

LANGDON, D. C.—Contract has been awarded by the Corby Company for the erection of a new boiler plant at its works in Langdon, to cost about $10,000, to F. L. Wagner, 1413 H Street, N. W., Washington.

WASHINGTON, D. C.—The Bureau of Yards and Docks, Navy Department, contemplates the construction of a power house at St. Julien's Creek (specification No. 3072), to cost about $75,000.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 5 for supplying to the various federel buildings, marine hospitals and quarantine stations under the control of the Treasury Department portable desk lamps during the fiscal year ending June 30, 1919.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing agent of the Post Office Department, Washington, D. C., until July 9 for furnishing electrical supplies, baggage trucks, etc., for the use of the postal service as they may be ordered from time to time during the fiscal year beginning July 1, 1918, and ending June 30, 1919. Blanks for proposal and further information may be obtained upon application to the purchasing agent.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to be delivered at the various navy yards and naval stations as follows: Various, Schedule 1839—182,000 dry flashlight batteries, 68,000 flashlights without batteries; Schedule 1857—miscellaneous dynamo, engine and fire room clocks; Schedule 1861—miscellaneous prismatic reflectors and globes, miscellaneous globes, shades, etc., Norfolk, Va.; Schedule 1845—400 single and double throw switch boxes, Brooklyn, N. Y. Schedule 1849—400 coaling trucks. Applications for proposals should designate the schedule desired by number.

North Central States

CINCINNATI, OHIO.—William T. Johnston Company, Third and Vine Streets, Cincinnati, is reported to be in the market for a 100-kw., 220-volt, three-wire gener-

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

ator directly connected to engine, (Skinner) preferred.

CINCINNATI, OHIO.—The Union Gas & Electric Company of Cincinnati has closed a contract with the United States government to furnish all the power required for the new intrate plant of the government to be located at Elizabethtown, about 20 miles from Cincinnati. The plant, it is expected, will be ready for full operation about Jan. 1, 1919, and will require about 35,000 kw. daily. Electricity will also be furnished by the company during the period of construction. A new station equipped with two generating units of 30,000 kw. each has just been completed. Work will begin at once on the installation of an additional unit of 30,000 kw., bringing the total output to 90,000 kw.

FINDLAY, OHIO.—The Grant Motor Corporation of Cleveland has awarded the W. J. Thompson & Son Company of Cleveland the general contract for the construction of three one-story buildings, 50 ft. by 190 ft., 50 ft. by 146 ft., and 30 ft. by 66 ft., respectively; two buildings, 50 ft. by 210 ft., and an office building, at its Findlay plant. The plant will be used for the machining of 155-mm. shells. The W. S. Ferguson Company of Cleveland has charge of the engineering work.

FULTON, KY.—The Illinois Central Railroad Company is contemplating the erection of various units at Fulton, including a boiler house, 40 ft. by 150 ft., two 150-hp. boilers, one 85-ft. electric turntable, etc., to cost about $225,000. A. S. Baldwin, 135 East Eleventh Street, Chicago, Ill., is chief engineer.

LOUISVILLE, KY.—The Board of Public Works has asked local architects to prepare plans for the proposed river warehouse and terminal. The installation of electrically operated trams to carry freight from the steamboats to the warehouses is under consideration.

LOUISVILLE, KY.—The Board of Water Works has authorized President S. Zorn to ask for bids for a new pumping engine, from 30,000,000 to 40,000,000 gal. per day, for the Crescent Hill plant, and also for the purchase of boilers and new equipment for the Riverside station.

MUNFORDVILLE, KY.—The Glen-Brook Power Company, recently incorporated with a capital stock of $30,000, is contemplating the construction of a power plant. R. D. Lane and others are interested in the company.

CANNELTON, IND.—Plans have been prepared for a new building, 230 ft. by 130 ft., at the works of the Indiana Cotton Mills, to provide space for additional looms. The building will be equipped with all modern appliances and will cost more than $200,000.

FRANKFORT, IND.—Steps have been taken by the City Council for improvements to the municipal electric-light plant.

HAMMOND, IND.—The Standard Steel Car Company has awarded contract to Manning, Maxwell & Moore for a 1000-ton hydraulic press to be installed in its Hammond works; also for accumulator, pumps and accessories.

INDIANAPOLIS, IND.—The Cleveland, Cincinnati, Chicago & St. Louis Railroad Company is contemplating new construction work involving an expenditure of about $11,000,000, which will include the construction of a new roundhouse and terminal at Galion, Ohio, to cost about $1,000,000, and improvements at its terminal in Cincinnati, to cost about $500,000. E. M. Costin, Indianapolis, Ind., is general superintendent.

NOBLESVILLE, IND.—Plans are being prepared by the Noblesville Heat, Light & Power Company for the erection of a dam across White River near Noblesville. It is estimated that sufficient power can be developed to operate about one-third of the plant. The cost of the work is estimated at about $100,000. A. R. Holliday of Indianapolis is president and general manager.

LINCOLN, ILL.—The City Council is considering an issue of $35,000 in bonds to acquire property necessary for the operation of the Lincoln municipal electric railway.

PEORIA, ILL.—Estimates are being secured by the Holt Manufacturing Company, which manufactures caterpillar tractors, on equipment for a new machine shop. The three shops now operated by the company are driven by electric power.

KENOSHA, WIS.—John D. Chubb, architect, 109 North Dearborn Street, Chicago, Ill., has been engaged by the Board of Education to prepare plans for two school buildings, each 150 ft. by 300 ft., two and three stories and basement, with manual training and domestic science departments.

KENOSHA, WIS.—Arrangements have been completed by the Winther Motor Truck Company, now operating at Winthrop Harbor, Ill., for the erection of a new plant in Kenosha, where a site of 10 acres has been acquired. The main building will be 125 ft. by 300 ft. Considerable machinery and tools will be required.

MADISON, WIS.—A site has been purchased in Madison by Armour & Company on which it is proposed to erect a new cold storage and refrigerating plant, warehouse and branch headquarters building, to cost about $75,000.

MILWAUKEE, WIS.—Plans have been completed and contracts will soon be awarded by the Globe Seamless Steel Tubes Company for the erection of two shop extensions, 130 ft. by 250 ft. and 130 ft. by 175 ft., at its main plant at Thirty-seventh and Burnham Streets, West Milwaukee. Orders, it is understood, will be placed at once for three electrically operated cranes and miscellaneous tools. Frank J. O'Brien is general manager.

RHINELANDER, WIS.—The Rhinelander Light & Power Company is contemplating the installation of a new turbo-generator unit (500 to 750 kw.) in its substation. Alterations and improvements in the waterworks station are also under consideration by the company. E. A. Forbes is president and general manager.

WAUSAU, WIS.—The installation of a central lighting and heating plant in Wausau is reported to be under consideration by local business men.

HATFIELD, MINN.—The local dam of the hydroelectric plant of the Wisconsin Railway, Light & Power Company was recently damaged, causing a loss of about $30,000.

ST. PAUL, MINN.—Bids will be received by the Minnesota State Board of Control, State Capitol Building, St. Paul, until July 2, for construction of the power house and laundry building and greenhouse, including general contract work, heating and ventilating, plumbing and electrical work, at the State Hospital for Crippled Children, Phalen Park, St. Paul. Plans and specifications may be obtained upon application to C. H. Johnston, architect, 715 Capital Bank Building, St. Paul, upon deposit of $25.

WAHKON, MINN.—The General Light & Power Company of Carlton has submitted a proposal to the Commercial Club to supply electric service to the village of Wahkon.

NEOLA, IOWA.—At an election held recently the proposal to issue $10,000 in bonds for improvements to the municipal electric-light plant and water-works system was carried.

SCHALLER, IOWA.—The Council is considering an issue of $35,000 in bonds for the installation of a municipal electric-light plant.

WATERLOO, IOWA.—Bids are being received by the Board of Education, Waterloo (to close in July, no date set), for the construction of the Kingsley High School, including electric wiring, steam heating, vacuum cleaner, etc. The cost of the building is estimated at from $140,000 to $150,000. J. G. Ralston, Syndicate Building, Waterloo, is architect. J. E. Dempster, Lovitt & Johnson Building, is secretary of board.

KANSAS CITY, MO.—The L. Breitag & Son Construction Company, 3701 West Prospect Street, has been awarded the general contract for the construction of substation No. 2 at 101 Oak Street, for the Kansas City Railways Company. The proposed building will be 82 ft by 48 ft., and will cost about $25,000. Contracts for electric wiring, heating, plumbing, etc., will soon be awarded. C. E. Fritts is electrical engineer.

ST. JOSEPH, MO.—Plans are nearing completion and bids will soon be asked for the construction of a store building, including electric wiring, steam heating, plumbing, etc., for the Townsend & Ueberrhein Clothing Company, to be erected at the corner of Sixth and Felix Streets, at a cost of about $100,000. The plans provide for the installation of one or two electric passenger and freight elevators. Eckel & Aldrich, Corby-Forsee Building, are architects.

WEBB CITY, MO.—The Southwest Missouri Railroad Company is contemplating the construction of a railroad from Pilcher to Miami, Okla., a distance of 18 miles, to cost about $150,000. The work will include roadbed, ties, rails, stations, cables, poles, cross-arms, etc. A. H. Rogers of Webb City is president.

PIERRE, S. D.—The municipal electric-lighting and water plant was recently destroyed by fire, causing a loss of about $100,000.

HAVELOCK, NEB.—Contract has been awarded by the Hebb Motor Company for electric wiring for its new manufacturing plant to W. H. Petersen. The cost of the plant is estimated at $250,000. W. J. Assenmacher, Orpheum Building, Lincoln, is general contractor. A. F. Hebb, 1333 P Street, Havelock, is owner.

SHELDON, NEB.—Contract will soon be awarded by the Nebraska Conference of Adventists, care of J. S. Rouse, College View, Neb., for the construction of a school dormitory, including electric wiring, heating, plumbing, etc. The cost of the building is estimated at about $60,000. Ellery Davis, Mutual Life Building, Lincoln, is architect.

AUGUSTA, KAN.—Bonds to the amount of $45,000 have been voted for improvements to the municipal electric-light plant.

CHENEY, KAN.—Preparations are being made by the city of Cheney to erect an electric transmission line from the line of the Tri-County Light & Power Company to Cheney, a distance of about 12 miles, for which bids have been received.

KANSAS CITY, KAN.—Contracts, it is reported, will soon be awarded by the St. Mary's Academy, Leavenworth, for the construction of a hospital, three stories, 50 ft. by 105 ft., with two wings, 50 ft. by 60 ft., on Eighteenth and Tauromee Streets, in Kansas City, to cost about $200,000. Wight & Wight, First National Bank Building, Kansas City, Mo., are architects.

MANHATTAN, KAN.—Bids will be received by J. A. Kimball, business manager, board of administration, Topeka, until July 9 for remodeling the old Agricultural Building at the Kansas State Agricultural College, to cost about $50,000. Proposals will be asked later (separate contracts) for electric wiring, heating, plumbing, etc. Ray L. Gamble, Topeka, is state architect.

MORAN, KAN.—Improvements are contemplated to the water-works system, including the installation of an engine and generating unit, to cost about $10,000.

PERU, KAN.—Preliminary plans are being prepared by Archer & Stevens, New England Building, Kansas City, Mo., for the construction of an electric-light plant and waterworks system in Peru, to cost from $30,000 to $35,000.

WOODSTON, KAN.—A company has been organized by local business men to construct and operate an electric-light plant in Woodston. The company is capitalized at $10,000. Frank Shuttee is president and P. D. Scott is treasurer of the company.

Southern States

BRADENTOWN, FLA.—The installation of a municipal electric-lighting plant is under consideration by the City Council.

MIAMI, FLA.—Owing to the government having commandeered the machinery ordered for the new municipal electric light and water power station, it will be some time before it will be ready for operation. Work on the new well is progressing.

ST. PETERSBURG, FLA.—Bids will be received by the Board of Public Instruction of Pinellas County, Dixie M. Hollins, superintendent, Clearwater, until July 9 for electrical work in the St. Petersburg High School, St. Petersburg. Specifications may be obtained from the superintendent, Clearwater, and William B. Ittner, architect, St. Louis, Mo.

COAL CREEK, TENN.—Contract has been awarded by the Magnet Knitting Mills of Clinton to the A. J. Stair Construction Company of Coal Creek for the construction of a mill building, 200 ft. by 60 ft., to cost about $20,000. The building will be equipped with 850 knitting machines driven by electric motors, costing about $50,000. Manley & Young, Holston Building, Knoxville, Tenn., are architects.

BIRMINGHAM, ALA.—Charles T. Lehman, 1921 Powell Avenue, Birmingham, is in the market for an air compressor of from 2000 to 3000 ft. capacity; three 150-hp Scotch marine boilers and locomotive, economic or other portable types, must be over 1000-lb. pressure; one 200 to 250-kw., direct-current generator and three 90 to 110-hp. portable locomotive boilers.

TUCKER, ARK.—The Pine City Electric Company of Pine Bluff has been awarded contract to install an electric-lighting system at Penal Farm, to cost about $3,500.

NEW ORLEANS, LA.—The economizer and boiler in the central power plant at Market and South Peters Streets of the New Orleans Railway & Light Company recently exploded, causing a loss of about $50,000.

NEW ORLEANS, LA.—Plans have been completed by the Foundation Company, 233 Broadway, New York, N. Y., for the construction of a new shipbuilding plant at New Orleans, which will include four shipways, with machine shop, fabricating shop

riveting works and other structures for the manufacture of steel vessels. The cost is estimated at about $1,000,000.

DURANT, OKLA.—The Durant Grain & Elevator Company, it is reported, will purchase machinery for an elevator with a capacity of 150,000 bushels and a mill with a daily output of 500 barrels. E. M. Stewart is manager.

PONCA CITY, OKLA.—The City Council is contemplating an issue of $35,000 in bonds for improvements to the municipal electric-light plant.

YALE, OKLA.—The City Council has engaged Henry A. Pressy, City Hall, Oklahoma City, engineer, to prepare plans for the proposed municipal electric-light plant and waterworks system. An election will soon be called to vote on the proposal to issue $200,000 in bonds for the work.

CHANDLER, TEX.—E. L. Green of Chandler, it is reported, is contemplating the construction of an electric-light and power plant in Chandler.

COLEMAN, TEX.—The City Council is considering extensions to the waterworks, involving an expenditure of about $100,000, increasing the capacity from 500,000 to 1,000,000 gal. The proposed work will include the construction of a pumping station and possibly a 5,000,000-gal. dam.

FORT WORTH, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 18 for the installation of an electric passenger elevator, etc., in the United States post office and court house at Fort Worth. For details see Searchlight section.

HOUSTON, TEX.—Contract has been awarded by the Houston, Richmond & Western Traction Company for the construction of the first section of 30 miles of its proposed electric railway that is to run between Houston and San Antonio, a distance of 186 miles, to Howard Kenyon of Houston. This section will extend from Houston to the Brazos River, a distance of 30 miles.

MARSHALL, TEX.—The Marshall Mill & Elevator Company is contemplating rebuilding its grain elevator and flour mill, recently destroyed by fire, at a cost of about $75,000.

MARSHALL, TEX.—Arrangements are being made by the Texas & Pacific Railway Company to rebuild its shops at Marshall, recently destroyed by fire. The loss is placed at $500,000, and includes main machine shops, tool room and power plant, air brake and coppersmith departments.

ORANGE, TEX.—The Orange Ice, Light & Water Company contemplates the purchase of a new 750-kw. generator and turbine and other machinery for its electric and water plant. It will also drill several additional artesian wells.

SABINAL, TEX.—The project of Charles A. Lindsey of Kansas City, Mo., and associates for the construction of a water storage and irrigation system near Sabinal, to cost about $3,000,000, it is reported, meets with the approval of the State Board of Water Engineers. The plans provide for the construction of a dam across the Frio River at a point where two bluffs make what is known as a shut-in of that stream, where a large hydroelectric power plant will be installed. From this plant transmission lines will be extended to San Antonio, Uvalde, Sabinal and other towns and cities within a radius of 125 miles. Water will be furnished at first to irrigate about 50,000 acres of land, and will ultimately be extended to 200,000 acres.

Pacific and Mountain States

OLYMPIA, WASH.—Application has been made to the State engineer by George W. Dilling of Seattle for 11,000 second-feet of water from Skagit River, to be used for power purposes. It estimated that 40,000 hp. can be developed at a cost of $2,000,000.

PE ELL, WASH.—The Central Light & Manufacturing Company of Pe Ell has been granted a franchise by the Commissioners of Lewis County to erect and operate an electric transmission line along the National Park Highway from Walville to Meskill and to use the streets of the unincorporated towns of Walville, McCormick, Doty, Dryad and Meskill. The franchise covers a period of 50 years. The company will connect with the lines of the North Coast Power Company at Meskill.

SEATTLE, WASH.—J. D. Ross, superintendent of lighting, will recommend the immediate change from fuel oil to some substitute (owing to the scarcity of fuel oil) at the municipal electric power plant at Lake Union.

WENATCHEE, WASH.—The Chelan Falls Power Company has applied to the Commissioners of Chelan County for permission to erect and operate an electric transmission in Chelan County.

KLAMATH FALLS, ORE.—The committee appointed by the City Council to consider the offer of the Keno Power Company to sell its light and power plant to the city, has reported that the city is financially unable to accept the offer.

PORTLAND, ORE.—The War Finance Corporation has given its approval of a loan of $1,000,000 to the Northwestern Electric Company of Portland. The proceeds will be used for extensions to its system to enable it to furnish additional energy to be used in connection with shipbuilding plants.

ALAMEDA CAL.—Work will be begun by the Bethlehem (Pa.) Shipbuilding Corporation on the construction of a new shipyard in Alameda on the San Francisco Bay. This yard will have its own fabricating machine, forge and boiler shops for making of all ship equipment. Orders, it is understood, will soon be placed for about 100 cranes, including both traveling and locomotive types.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has awarded contract for the construction of a substation at Slauson Junction to A. Nelson, at $3,341.

LOS ANGELES, CAL.—Government aid to the amount of $10,000,000 or more will be asked by the city of Los Angeles for the development of 210,000 hp. of hydroelectric power along the aqueduct under a plan launched by Mayor Woodman for a monopoly of power distribution in Los Angeles. Two objects are sought by the Mayor in the proposed project: First—To obtain a monopoly for the municipal power bureau of the distribution of power in Los Angeles; second—To release large quantities of fuel oil and natural gas now consumed by the gas and electric plants and private industries for domestic use. In return for this loan the city will offer the government first option on the 210,000 hp. of hydroelectric energy developed with this fund.

NEWPORT, CAL.—A committee has been appointed by the City Trustees to make investigations relative to the installation of electric lamps in Newport Heights. The city electrician, it is reported, has been instructed to purchase the necessary materials.

OCEANSIDE, CAL.—Plans are being considered by the Board of Supervisors for the installation of an electric street-lighting system in Oceanside.

RICHMOND, CAL.—Plans are being considered by the International Vegetable Oil Company for the construction of a large plant, which will require about 300 hp. in motors.

SAN FRANCISCO, CAL.—The Pacinc Gas & Electric Company has decided to increase the height of Lake Spaulding. It has not yet been decided whether to raise it 10 ft. or 15 ft., with cost $130,000 or $200,000 respectively.

SAN FRANCISCO, CAL.—Work is progressing rapidly on the Hetch Hetchy project. The Eleanor dam, it is expected, will be completed by July 1. The 4000-hp. hydroelectric power plant at Early Intake, in three units, will soon be placed in operation; the transformers, compressors and other equipment for tunnel aqueduct have been installed. At the end of this aqueduct the second large power plant of over 50,000-hp. will be started.

SAN FRANCISCO, CAL.—An agreement has been signed by the Pacific Gas & Electric Company, the California-Oregon Power Company and the Northern California Power Company whereby the three systems will co-operate to cope with the war-time shortage of power for expanding industrial needs. Under the arrangement made a supply of 8000 kw. additional energy will be assured to the Pacific Gas & Electric Company throughout the year and 12,000 kw. during the winter months. The new construction required in this plan will involve an expenditure of about $750 000, to be used as follows: (1) To reinforce and reconstruct the transmission line of the California-Oregon Power Company from Copco to Costella and to erect a 70-000-volt transmission line from Costella to Kennett of sufficient capacity to transmit 8500 kw. to the Northern California Power Company at Kennett; (2) the California-Oregon Power Company to finance the Northern California Power Company to the extent required to reinforce that company's line from Coleman to near Hamilton by the addition of a copper conductor to the west line to deliver to the Pacific Gas & Electric Company 8000 kw. at Colusa; (3) the Pacific company to erect a 60,000-volt transmission line from Colusa Corners, near Colusa, to the Drum-Cordelia; also to erect a 100,000-volt line and install a substation of 12,000-kw., 60,000/100,000 volts to deliver energy to that line. The construction work for the Pacific Gas & Electric Company will be in charge of P. M. Downing, chief engineer; for the California-Oregon Power Company, P. O. Crawford and W. W. Sheparad; for the Northern California Power Company, Edward Whaley, general manager.

SALT LAKE CITY, UTAH.—The Utah Power & Light Company has petitioned the Public Utilities Commission for permission to extend its system into the town of Perry, where it proposes to supply electricity for lamps, heaters and motors. The company has a franchise from the town for the proposed extension.

SALT LAKE CITY, UTAH.—Preparatory to beginning a large development, the Pope-Shenon Company, operating in the Salmon River country, has awarded a contract for the erection of a 9-mile electric transmission line, work on which will be started at once. The company has purchased considerable new machinery. The management, it is believed, will ultimately build a mill for the treatment of ores.

CONRAD, MONT.—Bonds to the amount of $10,000 for lighting system have been sold.

SANTA FE, N. M.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 10 for repairs to heating, plumbing, conduit and wiring and lighting fixtures, etc., in the United States courthouse, etc., at Santa Fe.

Canada

PRINCETON, B. C.—The Kettle Valley Railway Company, it is reported, has purchased the cement plant buildings and property at East Princeton, which includes the power plant now under lease to the Canada Copper Corporation.

VANCOUVER, B. C.—The B. C. Box Company is contemplating the construction of a mill and box factory, with a daily capacity of 20,000 ft. The proposed plant will be driven by electricity.

VANCOUVER, B. C.—The Beaver Cove Lumber & Pulp Company, London Building, Vancouver, is contemplating the construction of lumber and pulp mills at Beaver Cove, to cost about $250,000. W. H. White is general manager.

GLADSTONE, MAN.—The installation of a municipal electric-light plant to cost about $15,000 in Gladstone is under consideration.

GODERICH, ONT.—The National Shipbuilding Company is reported to be considering the construction of a factory and concrete boiler shops, to cost about $75,000.

PERTH, ONT.—The Hydro-Electric Power Commission of Ontario has purchased the High Falls power site at Perth.

WINDSOR, ONT.—Bid will be received by the Essex Border Utilities Commission at the office of Morris Knowles, Ltd., Royal Bank, Windsor, until July 8 for furnishing and testing three motor-driven pumping units, one having a normal rating of 500 imperial gal. per minute, and two having a normal rating of 1000 imperial gal. per minute. Plans and specifications are on file in the above office and in the office of Morris Knowles, Inc., 1200 Jones Building, Pittsburgh, Pa.

CHICOUTIMI, QUE.—The controlling interest in the property of the Saguenay Light & Power Company, which operates an electric light and power system in the town of Chicoutimi and surrounding country, has been acquired by the Chicoutimi Pulp Company, a subsidiary of the North American Pulp & Paper Company.

MONTREAL, QUE.—The high-tension transmission line of the Southern Canada Power Company with necessary substations, etc., connecting the cities of Sherbrooke and Granby and intervening territory has been completed and is now in operation. The substation is located in Granby. The company is also erecting an additional high-tensoin line between Drummondville and Sherbrooke.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until July 5 for furnishing refrigerating apparatus, block tin pipe, copper tubing, brass tubing, sheet brass, etc. Blanks and information relating to this circular (No. 1221) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

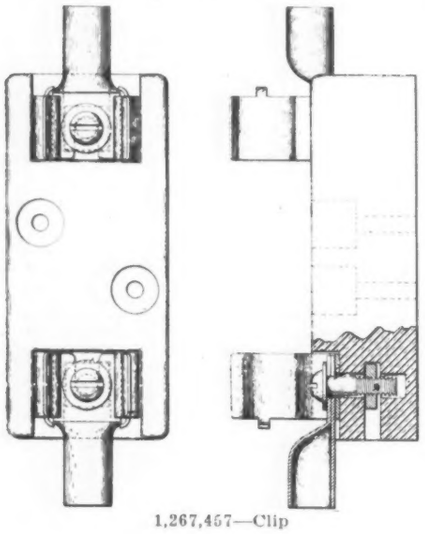
14,473 (reissue). TRANSFORMER; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed May 4, 1916. Relates to the windings and insulation of transformers which are adapted for use with very high-voltage circuits.

14,475 (reissue). LOAD INDICATOR FOR MOTOR TRUCKS; Frederick J. Troll, Baltimore, Md. App. filed July 20, 1917. Electromechanical means which may be applied to any motor truck.

1,265,121. FUSE DEVICE; Edmund O. Schweitzer and Alfred Herz, Chicago, Ill. App. filed March 13, 1914. Fuse devices intended for out-door overhead work.

1,267,418. SIGNALING HORN; William Kaisling, Chicago, Ill. App. filed June 11, 1914. Signaling devices for use with automobiles and motor boats.

1,267,433. AUTOMATIC SWITCH; James L. McQuarrie, Montclair, N. J. App. filed Dec. 30, 1916. Provides a switch for use in small telephone exchanges.



1,267,457—Clip

1,267,454. CIRCUIT CONTROLLER; Walter C. Reed, Dalton, Mass. App. filed Jan. 30, 1913. A circuit-controling device of that type in which provision is made for opening and closing one or more electric circuits.

1,267,457. CLIP; Joseph Sachs, Hartford, Conn. App. filed July 26, 1916. Provision by which a conductor can be maintained in electrical connection with the clip.

1,267,470. RINGER; Frank M. Slough, Elyria, Ohio. App. filed May 8, 1914. Ringers to be used in connection with telephones.

1,267,483. ELECTRIC CONTROLLER; Kenneth M. Walley, Chicago, Ill. App. filed Jan. 19, 1914. Mechanism for controlling the intensity of electric current.

1,267,516. LOCK SWITCH; Warren R. Cox, Cleveland, Ohio. App. filed Sept. 7, 1915. A lock switch for the electrical ignition circuit of an automobile engine.

1,267,538. AUTOMOBILE SIGNAL; Edward J. Gensler, Buffalo, N. Y. App. filed June 7, 1916. Traffic signals for use on automobiles.

1,267,587. SOUND-REPRODUCING APPLIANCE; Herman G. Pape, New York, N. Y. App. filed Feb. 28, 1916. Relates to improvements in telephone receivers.

1,267,603. ELECTRIC SNAP SWITCH; Clarence C. Stirling, Hartford, Conn. App. filed Oct. 19, 1917. Switching members that can be easily and readily snapped between on and off positions through the agency of a single element.

1,267,604. SNAP SWITCH; Clarence C. Stirling, Hartford, Conn. App. filed Oct. 19, 1917. Snap switches of type involving the use of only a single element.

1,267,633. AIR SPEED INDICATOR FOR USE ON AEROPLANES AND THE LIKE; Frederic H. Clift, Barnes, London, England. App. filed Sept. 21, 1917. Indicators for denoting the speed at which aeroplanes are traveling.

1,267,673. MEANS FOR BONDING RAILS; Frederick C. Lavarack, Orange, N. J. App. filed Jan. 18, 1914. Means for double bonding rails for railway signal work.

1,267,714. ELECTRIC CONTROLLER; Orne H. Torgersen, Chicago, Ill. App. filed June 11, 1917. Electrical controlling mechanism for compresed-air apparatus.

Record of Electrical Patents

Notes on Recent United States Patents

1,267,743. TELEPHONE SYSTEM; Wilson L. Campbell, La Grange, Ill. App. filed Oct. 7, 1907. Systems in which automatic service is provided.

1,267,751. VEHICLE SIGNAL; Harry C. Fairchild, Maplewood, N. J. App. filed Feb. 27, 1917. Vehicle signals operable in response to movement of the brake lever of the vehicle.

1,267,755. MAGNETO MACHINE; Harry E. Geist, Racine, Wis. App. filed April 12, 1916. Magnetos for ignition purposes.

1,267,767. STREET - TRAFFIC - CONTROLLING APPARATUS; Benjamin M. Harris, San Francisco, Cal. App. filed Oct. 18, 1916. Provides a variation in the character of the signals automatically.

1,267,784. TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Oct. 7, 1913. Automatic or semi-automatic telephone systems.

1,267,804. DEVICE FOR MOISTURE AND GAS PROOF TELEPHONE SETS; Eugene A. Reinke, Rochester, N. Y. App. filed May 13, 1915. Devices for use in mines.

1,267,817. SYSTEM OF CONTROL; Ray Stearns and William S. H. Hamilton, Schenectady, N. Y. App. filed March 24, 1916. An improved system of control for traction motors arranged for regenerative braking.

1,267,820. HOISTING SYSTEM; William C. Stevens, Summit, N. J. App. filed March 2, 1916. Hoisting systems for dock hoists.

1,267,828. DYNAMO - ELECTRIC MACHINE; John B. Wiard, Lynn, Mass. App. filed Sept. 28, 1917. Relates to the ventilation of dynamo-electric machines.

1,267,832. FILLED CABLE AND FLUID STOP; James Wilkinson, Pittsburgh, Mass. App. filed June 2, 1917. Provides a method of filling a portion of a stranded cable with a solidifiable fluid.

1,267,838. DYNAMO - ELECTRIC MACHINE; Sven R. Bergman, Lynn, Mass. App. filed Jan. 12, 1911. Means for ventilating dynamo-electric machines efficiently.

1,267,868. ELECTRIC CONDUCTOR; William C. Havman, Schenectady, N. Y. App. filed March 9, 1916. Insulated electric conductors having coverings provided with one or more colored marking threads.

1,267,875. CASING FOR LAMP SOCKETS AND THE LIKE; Charles J. Klein, Milwaukee, Wis. App. filed April 8, 1912. Relates to incandescent lamp sockets, and more particularly to the non-current-carrying parts of such devices.

1,267,911. DISTRESS SIGNAL; Maurice Scholder, New York, N. Y. App. filed Oct. 13, 1916. Distress signals and fire alarms.

1,267,914. ELECTRICAL MEASURING INSTRUMENT; Robert Shand, Lynn, Mass. App. filed May 19, 1916. Improved instrument of the solenoid type.

1,267,916. SYSTEM OF CONTROL; Frank H. Shenard, New Rochelle, N. Y. App. filed April 29, 1915. Control systems for electric railway motors.

1,267,969. CURRENT-CONVERTING MACHINE; Arthur R. Bullock, Cleveland, Ohio. App. filed June 19, 1913. Provides a device in which the current converted is commutated.

1,267,980. AUTOMATIC TELEPHONE - EXCHANGE SYSTEM; Edward B. Craft, Hackensack, N. J. App. filed Dec. 19, 1914. Automatic switches for distributing calls.

1,267,983. DYNAMO - ELECTRIC MACHINE; James F. Curtis, Pitcairn, Pa. App. filed Feb. 9, 1914. Provides means for the reliable ventilation of certain types of dynamo-electric machines.

1,267,987. AUXILIARY SIGNAL SYSTEM; Lewis Degen, Pasadena, Cal. App. filed May 11, 1917. Signaling system for sending and receiving fire alarms.

1,267,993. DYNAMO - ELECTRIC MACHINE; George M. Eaton, Pittsburgh, Pa. App. filed May 4, 1915. Field-magnet pole pieces built up of laminations.

1,267,996. COIL SUPPORT FOR DYNAMO-ELECTRIC MACHINES; Allan B. Field, West Cliff-on-Sea, England. Provides means for bracing and spacing the overhanging end portions of coils of such machines.

1,267,997. COIL-SUPPORTING MEANS; Allan B. Field, West Cliff-on-Sea, England. App. filed Jan. 30, 1914. Means for supporting the overhanging end portions of coils of such machines.

1,268,014. AUTOMATIC PROTECTIVE DEVICE; Karl Karppinen, Brisbane, Queensland, Australia. App. filed June 7, 1917. An automatic device for shunting excessive electrical potentials and amperages.

1,268,020. VENTILATING APPARATUS; Jan A. Kuyser, Edgwood, Pa. App. filed March 3, 1914. Ventilating means for dynamo-electric machines provided with two-layer armature windings.

1,268,025; ARC LAMP; George M. Little, Pittsburgh, Pa. App. filed Oct. 3, 1913. Improvements in supporting and guiding means for the movable electrodes of such lamps.

1,268,026. ARC LAMP; George M. Little, Pittsburgh, Pa. App. filed April 6, 1915. Regulating and feeding mechanisms of focusing-type arc lamps.

1,268,052. SYSTEM OF CONTROL; Laurence M. Perkins, Wilkinsburg, Pa. App. filed March 13, 1916. Systems of control of electric railway motors and the like during the regenerative period.

1,268,068. AUTOMATIC MANUAL TELEPHONE SYSTEM; Bernard D. Willis, Chicago, Ill. App. filed Jan. 18, 1910. Systems in which automatic switches are employed.

1,268,069. AUTOMATIC COMMON-BATTERY TELEPHONE SYSTEM; Edward D. Fales, Chicago, Ill. App. filed Nov. 6, 1906. Provides certain features of improvement.

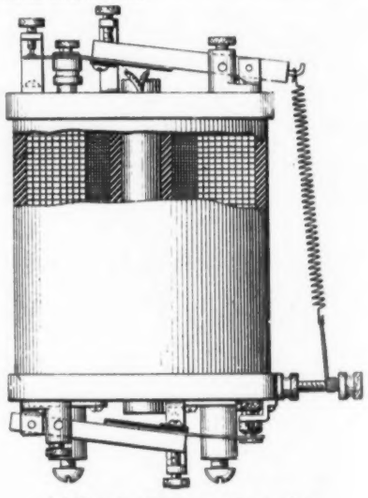
1,268,072. COMBINED SELECTOR AND REPEATER APPARATUS FOR LOCAL-BATTERY TELEPHONE EXCHANGE SYSTEMS; Talbot G. Martin, Chicago, Ill. App. filed July 22, 1907. Relates to automatic or semi-automatic telephone exchange systems.

1,268,102. ELECTRIC LIGHT EXTENSION DEVICE; John B. Drumm, Winslow, Ariz. App. filed Aug. 31, 1914. Provides a compact drum mounting wherein the contacts are completely housed.

1,268,106. TELEPHONE SYSTEM; Adolf Franke, Grunewald, near Berlin, Germany. App. filed Sept. 3, 1913. Automatic telephone systems in which connections are established by means of selectors.

1,268,111. SYSTEM OF CONTROL FOR ELECTRIC ELEVATORS; Floyd C. Furlow, Montclair, N. J. App. filed Nov. 5, 1915. Provides means to control an elevator car automatically.

1,268,154. HANDY LAMP; Ralph R. Root, Cleveland, Ohio. App. filed May 4, 1914. A handy lamp that may be affixed upon a metal surface and supported by magnetic attraction.



1,267,483—Electric Controller

1,268,156. CONTROL MECHANISM FOR AUTOMATICALLY OPERATING APPARATUS; Harold Rowntree, Kenilworth, Ill. App. filed Sept. 29, 1913. Provides means for successively registering the calls for the operations of the apparatus.

1,268,173. ELECTRIC SWITCH; Alfred J. Stecker, Detroit, Mich. App. filed Jan. 18, 1917. Electric switches which may be conveniently operated by the thumb or finger.